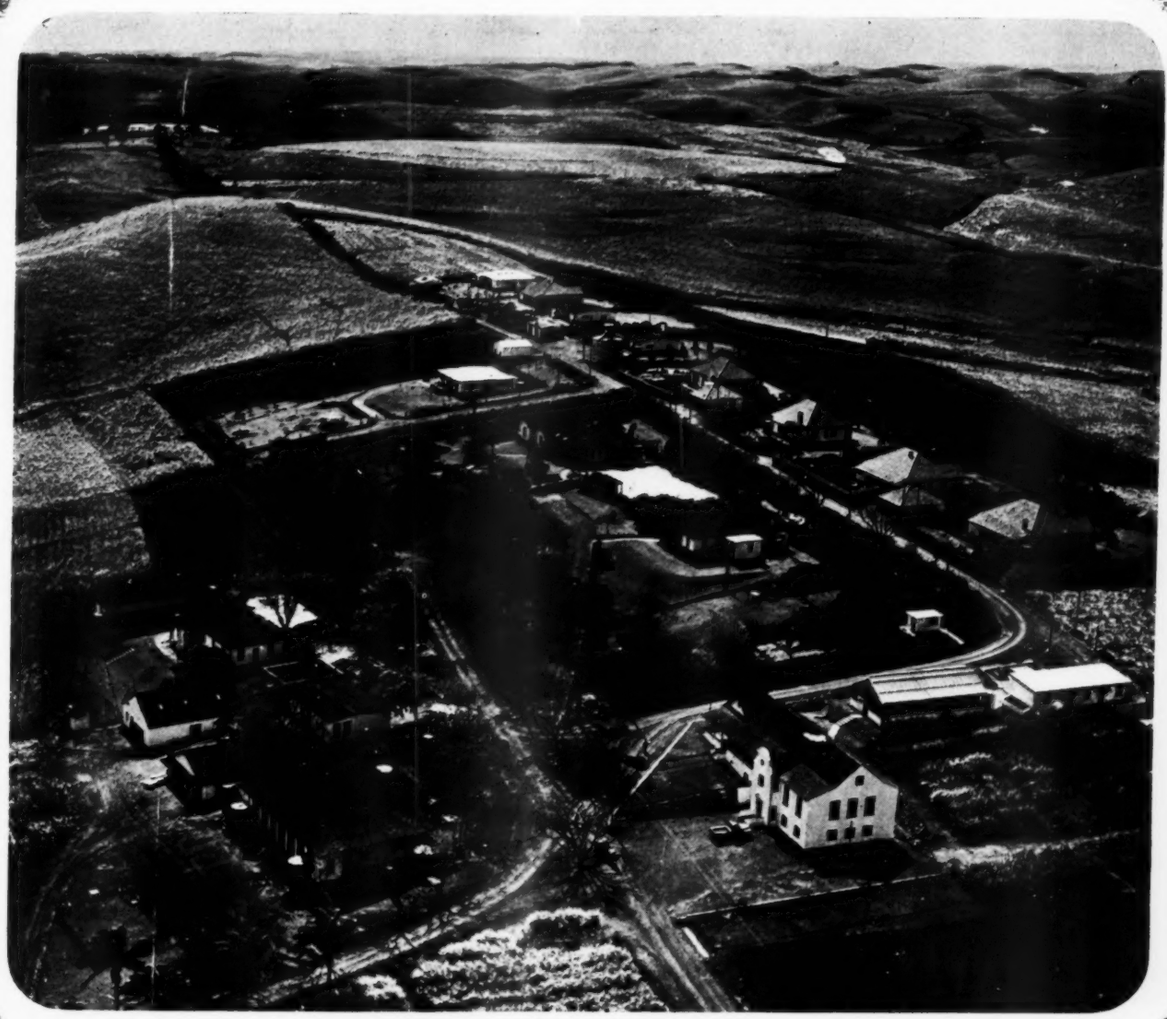
RSITY
OCT 9 1951
FORESTRY
LIBRARY

WORLD CROPS

THEIR CULTIVATION, PROTECTION, STORAGE, HANDLING AND PROCESSING FOR FOOD, FODDER, AND INDUSTRIAL PRODUCTS



VOLUME 3, No. 10 OCTOBER 1951

A Publication of The Leonard Hill Technical Group

MONSANTO CHEMICALS FOR EVERY INDUSTRY

To formulators of

INSECTICIDES, WEED-KILLERS, FUNGICIDES

A new range of agricultural chemicals by Monsanto

NIRAN	Diethyl paranitro-phenyl-thiophosphate	Organic phosphorus insecticide	When formulated, controls aphides, mites, grasshoppers, scale and thrips. Compatible with other insecticides and fungicides.
2.4-D	2.4-Dichlorophenoxy-acetic acid Sodium 2.4-Dichlorophenoxy-acetate-monohydrate	Hormone-type herbicide	Toxic to non-grassy plants. Used for weed control in grassland, turf and cereals.
SANTOBRITE	Sodium pentachloro-phenate	Contact herbicide, water soluble	For control of broad-leaved weeds.
SANTOPHEN 20	Pentachlorophenol	Formulated as an oil emulsion spray	Toxic to broad-leaved weeds and grasses.
DIPHENYL	Diphenyl	For impregnation of fruit wrapping-paper.	

and a valuable list of chemicals for use as —

WETTING AGENTS	SANTOMERSE	For fruit and vegetable washing, dairy cleaning, general farm cleaning. Formulation of wettable powders and insecticidal sprays.
WOOD PRESERVATIVES	PERMASAN	To protect against bacteria or fungi. Applied by dipping, brush or spray.
SOIL STERILISERS	CRESYLIC ACIDS, CHLORINATED CRESYLIC ACIDS	All grades, blended to customers' requirements for this purpose.
MASKING AGENT for insecticides	METHYL SALICYLATE	As a masking agent for kerosene and other insecticide spray oils.

MONSANTO

MONSANTO CHEMICALS LIMITED, ALLINGTON HOUSE, LONDON S.W.1

WORLD CROPS

Editor: Sir Harold A. Tempany, C.M.G., C.B.E., D.SC., F.R.I.C.

VOL. 3 No. 10 OCTOBER 1951

CONTENTS

EDITORIAL COMMENT:
Mediterranean Fodder Resources; Agricultural Research in the British Colonies; Molasses and Soil Structure; Fertiliser Placement; Synthetic versus Natural; The Case for Natural Rubber; Agricultural Research in Europe 371

The Natal Sugar Industry—*A. C. Barnes*, C.M.G., B.SC., F.R.I.C. ... 375

The Assessment of Fodder Resources—*R. O. Whyte*, PH.D., B.SC. ... 379

Potato Silage in Holland—*Dr. Tjalling Bakker* ... 383

Virus Diseases of Crops in East Africa ... 385

Australia—Britain's Vineyard ... 387

East African Agricultural Research ... 390

The Inter-American Institute of Agricultural Science 391

The Rejuvenation of Ceylon's Coconut Plantations 394

Imperata Grass ... 396

Better British Farming ... 397

Oil Fractions as Selective and Total Weedkillers —*G. E. Barnsley* ... 399

Developments in the World Raw Cotton Situation 402

Tea in Japan: A Review—*Peter de Jong* ... 404

Research Developments ... 407

Farm Machinery: 'Rotary Atomisation'; Seed Cleaners and Graders; New Electric Fence Equipment; Crushing and Grinding; Tractors for Sokoto Rice Project ... 409

New Books ... 411

Correspondence ... 412

World Crop Reports ... 413

Published monthly by Leonard Hill Limited, 17 Stratford Place, London, W.1, England. (Tel. Mayfair 7383)
U.S.A. 17E 48th Street, New York City. (PLaza 5-1127)

Subscription rates: *1 year 5 dollars, 3 years 10 dollars, paid in advance*

RECOGNISED AS THE BEST

"RIGHT ROUND THE WORLD"

The world-wide reputation of the Wolseley Electric Fencer has been well earned by the first-class service it has always given. For the successful and speedy operation of rotational or strip grazing, it is indispensable. Its light weight and easy erection make it the ideal equipment for this grazing system.

WOLSELEY

ELECTRIC FENCING

WOLSELEY SHEEP SHEARING MACHINE COMPANY LIMITED, WITTON, BIRMINGHAM, 6

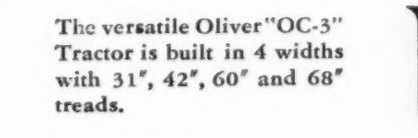
OLIVER

Crawler Tractors

. . . in All Sizes
. . . for All-Purpose, All-Weather Farming

Farms can be made to produce more crops when Oliver Crawler Tractors are used. These powerful tractors with continuous power on both tracks can operate in any weather and ground conditions. They keep farming on schedule, enable you to work land that is hard to farm.

The Oliver "OC-3" Crawler Tractor shown is powered by an efficient 4-cylinder gasoline or KD engine that gives you maximum fuel economy. It is ruggedly built for years of hard service. A full line of matched farm equipment is available. See your Oliver Distributor for the "OC-3" or larger Oliver Crawler Tractors.



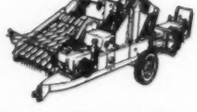
The versatile Oliver "OC-3" Tractor is built in 4 widths with 31", 42", 60" and 68" treads.

OLIVER

THE **OLIVER** CORPORATION

Export Division,
400 W. Madison St., Chicago 6, Ill., U. S. A.

"FINEST IN FARM MACHINERY"



Oliver also builds Wheel Tractors, Hay Balers, Cultivators, Disc Harrows and other equipment.

Editorial Comment

Mediterranean fodder resources

IN this issue we print an article by Dr. R. O. Whyte, the well-known British authority on pasture and fodder resources, on the importance of assessing these in practice and the methods that can be employed in so doing.

The ability of a country to maintain and increase its supplies of animal foodstuffs is dependent on pasture and fodders. The diets of most of the poorer regions of the world are today markedly deficient in protein foods, and the increase of the animal food, meat, milk and milk products, poultry and eggs is an urgent necessity. This obviously depends on increasing the quantity and availability of animal foodstuffs and this in turn largely hinges on the improvement of pastures and fodder resources which in many countries are at a lamentable low level. The assessment of existing resources is a first and obvious step.

In no part of the world is this deficiency more in evidence and more urgent than in the Mediterranean countries. For centuries much of the grazing land has been abused and its productive power diminished by unsuitable practices; there has been widespread erosion and loss of fertility. During the past few years this matter has attracted attention in the international sphere and under the aegis of OEEC and FAO a series of survey groups have been conducting surveys of the fodder resources in certain of the Mediterranean countries. The teams included expert workers from the U.S.A., South Africa, Australia, and the United Kingdom, and among them Dr. Whyte himself was included.

The report of these teams has recently become available and formed the subject of an International Conference held in Rome last June; it was organised jointly under the auspices of the Italian Ministry of Agriculture, OEEC and FAO, under the chairmanship of the Italian Minister of Agriculture, its members including representatives of many European and other countries.

We hope to publish a review of the main facts brought out in the reports in a forthcoming number of WORLD CROPS and here it may be said that it was established that by the use of modern methods in replacement of traditional practices, and especially by combining crop and livestock farming into systems of mixed husbandry, fodder production and, in consequence, animal production could be increased by at least 50%.

If this increase could be achieved it would be a major contribution to the solution of the food problems of that populous and undernourished region. Food shortages lie a the root of much of the existing political instability and an improvement of this order would be a potent factor in securing world peace.

No doubt the conference and the investigations which led to it were an important step in the right direction and an example of the way in which international collaboration can pave the way for economic improvement. Let us hope that the recommendations of the reports which were strongly endorsed by the conference will in due course be translated into effective action by the countries concerned.

Agricultural Research in the British Colonies

THE Second Annual Report of the East African Agricultural and Forestry Research Organisation, reviewed on another page, and the General Report on Research in the Colonial Dependencies referred to in our September issue, call for some comments on the organisation of agricultural research in that wide and diverse field.

It is nearly 25 years since the Imperial Agricultural Research Conference held in London, in the summer of 1927, drew attention to the need for better provision in this regard and proposed what it termed a ' chain of research institutes ' in the various colonial regions to serve the colonies as a whole, and deal with every aspect of agricultural research. Only two of these actually materialised, viz.: The Imperial College of Tropical Agriculture in the West Indies and the East African Agricultural Research Institute at Amani, which has now become absorbed into the East African Organisation. Both were handicapped by inadequate provision of staff and funds but both succeeded in accomplishing a great deal of useful work. Meantime the specialist staffs of many local departments of agriculture were strengthened and a large number of research organisations sprang up to meet the research needs of particular industries and crops. Examples of the latter are the Rubber Research Institute of Malaya, the tea, rubber and coconut research schemes in Ceylon (which had not then attained Dominion status), the sisal and coffee research stations in Tanganyika, the sugar cane breeding stations in the West Indies and Mauritius, and a number of others. Many performed and continue to accomplish valuable work, although with the exception of the Rubber Research Institute in Malaya and a few others most of them were handicapped by lack of funds and inadequate staff.

Agricultural research activities in the colonies were greatly restricted during the 1939-45 War owing to the diversion of staff to other duties and it

was not until the post-war period that they were resumed. It is, however, greatly to the credit of the British wartime coalition Government, under Mr. Churchill, that, despite preoccupations with military questions, it realised that recovery in the Colonies in the post-war period depended very largely on the extension of all aspects of research and set up a Colonial Research Committee under the chairmanship of Lord Hailey to examine the whole position.

A special sub-committee of the body examined the agricultural requirements and came to the conclusions (*a*) that there was need for extension of the existing provision and (*b*) that the form of organisation needed revision. They saw that a large number of specialised crop stations, each covering a restricted field, plus two general stations, mostly insufficiently staffed and financed, did not meet requirements adequately. They proposed the creation of a series of regional agricultural research organisations to serve the main geographical subdivisions, which would perform the essential basic research and survey work, provide a link with the crop research stations and the research work of the local department workers and which could be drawn on to deal with special problems as they arose. By means of regional research councils and committees they would be linked to a central committee in Great Britain, which would facilitate the examination of new projects and the interchange of research workers in the mother country and the Dominions with the Colonies.

The first fruits of all this planning are now to be seen in the East African Organisation and the greatly extended activities of the Imperial College of Tropical Agriculture in the West Indies. The possibility of creating similar organisations in other parts of the Colonies is under consideration, notably in West Africa and Malaya. It is to be hoped that they will materialise since this form of organisation has obviously much to commend it, and while we must await further experience until a final verdict can be pronounced, the present indication is that it is well suited to the needs.

Difficulties are, of course, inevitable; one of the chief is that of recruiting necessary qualified scientific staff, and here much depends on conditions of employment. There is at present a regrettable, although perhaps justifiable, reluctance among scientific workers to engage in work in the Colonies by reason of doubts about political stability and consequent security of employment. In the present fervour for nationalism and political quasi independence there is indeed a risk that these may be accentuated since local politicians often aspire to see employment restricted to nationals of their particular territory, sometimes regardless of their ability and qualifications.

It would indeed be tragic if the political aspirations which have of late years been so sedulously fostered should defeat their own ends by creating local atmospheres in which the research, which must be the basis for development and improved living standards, cannot be carried out.

Molasses and soil structure

FOR many years the disposal of waste molasses from the manufacture of sugar was a problem. Of late years it has ceased to be so, owing to the increasing demand for this waste product either for the production of alcohol or the manufacture of citric acid and other products by the mould fermentation process.

In many cane sugar producing countries it was formerly customary to apply surplus molasses to the fields as a manure, notably in the sugar producing island of Mauritius. Numerous experiments and the experience of planters showed that such dressings were productive of considerable increases of yield amounting, in many cases, to as much as 10 tons of cane per acre or even more. The effect was greatest in the first crop of plant canes and became progressively less in subsequent ratoon crops. Although the benefit was undoubted, the cause of the increase has for long been in doubt. Early workers attributed it to biological factors which were supposed to be stimulated by the influence of the residual sugar in the molasses on the soil flora, increased fixation of nitrogen from the atmosphere by azotobacter and increased nitrification having been suggested as being among the causes. No doubt the effect was partly attributable to the effect of potash, of which molasses contains relatively large quantities, but comparative experiment suggested that this was not the whole cause. Other and later suggestions have been the stimulation of the production of antibiotics in the soil as the result of increased mould growth.

In a paper presented to the Seventh International Congress of Sugar Technologists held in Brisbane in September last Messrs. Vallance and Leverington recorded that, as the result of laboratory experiments, the application of molasses or sweet sorghum residues to the soil led to the improvement of soil structure and to increased stability of soil aggregates. They attributed this to the proliferation of the mycelium of certain fungi, the hyphae of which bound the soil particles together. They consider that the improvement of the soil structure thereby engendered accounts for the increased yields obtained.

They further suggest that on account of the richness in sugar of the crop residues from sugar cane cultivation such as roots and sugar cane stools left in the field after the crop, the cultivation of sugar cane itself exercises an ameliorating influence on the soil.

In an article which appeared in the January 1951 issue of WORLD CROPS on Soil Structure, Dr E. W.

Russell mentions this action of soil inhabiting fungi in improving structure by the binding action of the hyphae as well as the cementing action of microbial lignins and gums which are formed by bacterial action from carbohydrates and may be of importance in tropical soils. A further point is that the roots of some, though not all, grasses have a profound effect on soil structure exercising themselves a binding effect on soil particles. It is now more or less generally accepted that a rotation which incorporates a period of several years under grass is probably the best agricultural system for medium rainfall regions in the tropics.

Sugar cane is itself a grass; experience in the West Indies and elsewhere has shown that it can be cultivated continuously on the same lands for very long periods without sensible deterioration of the land. It seems at least possible that a rotation which incorporates sugar cane may be at least an acceptable alternative for one which includes a grass ley under tropical conditions.

Moreover, does it not at least seem possible that the beneficial action of sugar cane and other grasses may lie not only in the ameliorative effect on soil structure, but that the accumulations of carbohydrates in the roots also exercise an influence on the far too little understood biological processes of tropical soils?

Fertiliser placement

BRITISH research continues to show that the advantage in placing a fertiliser dressing close to the seed is limited to cereals or other quickly-growing and shallow-rooted crops. For crops that root deeply and enjoy a long growing season the traditional method of broadcast application is as efficient as band or strip placement. The latest report from Rothamsted gives the results of 10 experiments in 1949 with broadcast and placed dressings for sugar-beet. Germination was not damaged by placed dressings 2 in. to the side of the seed but yields were not significantly different from yields with normally broadcast dressings. So far 31 tests in 1947-49 have been reported from this research and on the whole the broadcast dressings have given better yield increases for both sugar and beet tops.

For winter beans, spring beans and peas similar tests in 1950 showed yield advantages from placed dressings. The advantages were considerable, half the quantity of fertiliser giving better yields than broadcast dressings. But with carrots broadcast dressings were superior to placed dressings.

It seems clear that the value of placement depends upon the nature of a plant's root system. A broadcast application tends to saturate a larger zone of soil with nutrients and if a deep and extensive root system occupies the soil for a sufficiently long growing period this bigger ' larder ' of food in the soil is better suited to plant requirements. The deeper-rooted and longer-growing crop obtains no benefit from a more concentrated food-supply. On the other hand labour may sometimes be saved by placed fertiliser applications, and if yields are not significantly less and there is no damage to seed germination, there is still an economic case for considering placement rather than broadcasting.

Synthetic versus Natural

THERE are people in this world who profess to look forward to a future in which the world will be free from what they term the ' domination of the plant ' as the source of raw materials for manufacture. They envisage an age of what has been termed ' chemocracy ' in which the chemist will be supreme and will provide most of man's requirements by chemical synthesis with the added advantage that the materials so produced will be much more uniform in quality and dependable than their natural competitors and much more economically produced. They point with pride, admittedly not unjustifiably, to such achievements as the supersession of the vegetable dyes, indigo and alizarin, by synthetic products or to the more recent large-scale production of synthetic rubber or fibres, and they envisage with joy the indefinite extension of this process.

Personally we doubt whether these roseate visions are ever likely to materialise to the extent they anticipate. For one thing the raw materials *par excellence* upon which the organic chemist relies for the starting point of his operations are predominantly derived from coal and crude oil supplies, which themselves are expendable substances, within the foreseeable future, while for another they are themselves the products of vegetational activity of a bygone age, metamorphosed by naturally occurring chemical reactions. The protagonists of synthesis are thus still dependent upon the plant for their raw material, notwithstanding that the life of this material ended millions of years ago.

Does not the future of raw materials therefore still lie with the cultivator? When the supplies of coal and crude oil are exhausted where can the manufacturer turn to replace the dyes, the fibres and the rubber which he needs save to the plant? Granted that the products of chemical synthesis can be made to conform more closely to the manufacturers' requirements than many of the natural products do at present; granted moreover that the skill of the chemist will undoubtedly enable him to use as the basis for his synthesis other materials than the coal and oil products upon which he at present relies (indeed the development of so-called chemurgy is a clear pointer that this may be already occurring), but for these must he not perforce turn to the products of recent plant activity instead of

relying on the fossilised residues of plant growth in bygone ages?

Is not the future therefore largely bound up with man's ability to control more closely the plants' activities so that they will yield in increasing quantity and improving quality products more and more exactly suited to the manufacturer's requirements, rather than with attempts to evade the necessity for making use of plant products at all. The plant breeder has already given abundant proof of his ability to modify and improve plant products and the line of progress most likely to be fruitful of useful results appears to lie in greater collaboration between the plant breeder and the chemist rather than in rivalry.

Therefore, let the cultivator be not dismayed by the seemingly dazzling triumphs of the chemist in producing synthetic substitutes for the crops he grows, since in the long run it seems inescapable that man must always continue to rely on vegetational activity for most of his food and raw materials.

The case for natural rubber

PARTICULAR point is given to these reflections when one considers the case of the competition of natural with synthetic rubber, which was dealt with in a paper read last May by Dr. A. van Rossem, Director of the Rubber Institute at Delft in Holland, before the Institution of the Rubber Industry in London.

Dr. van Rossem stressed the urgency of the threat to natural rubber from synthetics particularly because of the variability of the natural product, especially in such matters as plasticity, rate of cure, oil resistances, cleanliness, etc. — disadvantages which are present only in a very minor degree in the synthetic substitutes.

He pointed out that one cause of this variability is that plantation rubber is produced in a very large number of relatively small factories, and he urged the desirability of their supersession by a smaller number of large central factories, since this would facilitate large-scale bulking and enable a much greater degree of scientific control of the processing, leading thereby to much greater uniformity; it would also facilitate the application of new and better methods of preparation.

He pointed out that, thanks to the provision of ample facilities for research, the plantation industry of the East had been able greatly to increase rubber yields, and expressed the view that this should also enable the industry to meet and overcome the present competition with synthetics. If, however, the processing of rubber continued to be carried out in small factories, he could see little hope of its so doing and *a fortiori* if a large bulk of the produce continued to be obtained by individual processing on small holdings.

Many of the properties of rubber, such as plasticity, depend on molecular distribution; there is some evidence to show that the molecular configuration of rubber in the tree itself becomes sensibly modified after it has become extracted by tapping. This question is at present under investigation at the Rubber Research Institute of Malaya. The possibility of modifying the rubber molecule either in the tree itself or after it leaves the tree, to produce rubbers of varying properties seems within the bounds of possibility.

The possibilities here cannot be overlooked although Dr. van Rossen himself was somewhat doubtful about them; he however affirmed his strong belief in plants as chemical factories.

When we consider that the rubber tree *Hevea braziliensis* can in a few hours or days synthesise, by its subtle chemical mechanism, the remarkable and complex hydrocarbons which we call rubber, from carbon dioxide and water with the aid of elements drawn from the soil, do not achievements of the chemist, great though they may be, pale into insignificance?

Agricultural research in Europe

IN another column there appears a brief account of the Conference on the Organisation of Agricultural Research in Europe convened by FAO which is scheduled to take place in London this month.

It is not always appreciated that the administration and co-ordination of research can be just as important as the conduct of the research itself. Only if the programmes of research are properly co-ordinated and the necessary priorities assigned to them can they be fully effective. In the United Kingdom the existing organisation, whereby the Agricultural Research Council is linked to the Agricultural Improvement Council gives clear indications of the directions in which research is needed and makes the necessary arrangements for carrying it out; it has already given abundant proof of its value.

If, as a result of this conference the way can be paved for some arrangement on international lines whereby agricultural research in European countries this side of the Iron Curtain is co-ordinated as a whole, it would be indeed a notable advance, since it should help to eliminate much of the overlap of projects and the uneconomic use of scientific personnel, so liable to occur at present, and which is so greatly to be regretted in the existing shortage of scientific manpower.

THIS MONTH'S COVER

The Sugar Research Station at Mount Edgecombe, Natal, established in 1925. The work of this station has been a major contribution to the progress of South Africa's sugar industry, particularly in regard to improved commercial varieties. An article on the Natal sugar industry appears in this issue.

(Photo: South African Sugar Association)

Left—**The sugar factory of Natal Estates Ltd.** *Right*—**Esperanza mill**

The Natal Sugar Industry

A. C. BARNES, C.M.G., B.Sc., F.R.I.C.

Sugar growing in South Africa is now a large and important industry. Its growth has been phenomenally rapid and it provides an excellent example of the manner in which an agricultural industry has been built up by the intelligent co-operation of private enterprise with Government encouragement and assistance. The account is written by Mr. A. C. Barnes, until lately Director of Research to the Sugar Manufacturers' Association of Jamaica, who has recently paid a visit to South Africa. He will be well known to our readers as the author of articles which have previously appeared in* WORLD CROPS *on the West Indian Sugar Industry.

THOUGH early records state that sugar cane was present over 300 years ago in what is now Natal, the cane sugar industry of South Africa originated from introductions of plants from Réunion into Natal just over a century ago. The first sugar is believed to have been made in 1849, and a few years later the industry became firmly established, the production of sugar amounting to 3,500 tons in 1860.* The first 'large' mill was erected at Mount Edgecombe in 1877, with a daily output of 20 tons of sugar.

Progress was hampered by inadequate transport and labour. At that time there were difficulties in obtaining native labour, but in 1860 Indians were brought in under an indenture system, a practice which continued until 1911. Among other difficulties of those early years, some of which have persisted until recent times, were problems of competitive selling in low price markets, internal trade barriers among the individual territories which now form the Union of South Africa, and diseases of the cane. The first sugar planter's conference was held in Durban in 1888, but it was not until 1909 that a sugar planters' association was formed representing the whole industry.

* Records of the beginning of cane sugar production in Natal are conflicting. The South African Sugar Association has recognised this year (1951) as the centenary.

Growth of the industry

The growth of the industry during the past 50 years is remarkable. From an average annual production of 26,000 tons for the five years 1900-1904, the output has increased more than 20 times to 568,700 tons average for the last five years, the record crop of 685,798 tons of sugar being made in the season which was completed in January 1951.

Until 1932 increased areas under cane were the main factor, notably the effect of plantings in Zululand* from 1909 onwards. The rising output of the past two decades is due mainly to new varieties, combined with improvements in field practice and mill recoveries. Further considerable expansion in accordance with a policy adopted in 1948 is confidently expected, the production target being 725,000 tons in 1953.

* Zululand was incorporated in Natal in 1897 and now forms a part of that province.

Location of the industry

The industry is localised in the coastal lands of Natal ranging for 200 miles from Port Shepstone in the South to Mtubatuba in the North. This zone of undulating and hilly land, with occasional alluvial flats which increase in area towards the north, never extends to more than a few miles from the sea. The total area devoted to cane now closely approaches 450,000 acres, of which about one half is harvested each year, reported figures for 1947/48 being 387,475 and 185,667 acres respectively. In 1950 the area harvested was 220,545 acres. At the end of 1949 there were some 80,000 acres of virgin land suitable for sugar cane within the existing sugar belt. The development of new lands to the east and north is under active notice.

Those who are familiar with conditions in the West Indies, will find major points

of difference in certain features of the growing of sugar cane in Natal. The low rainfall which compares with Antigua and the drier irrigated lands of Jamaica, the rolling slopes and hillsides, in some cases too steep for mechanical cultivation, the absence of regularly shaped fields, except in the flat areas to the north, and the high proportion of cane grown by farmers are notable. Extensive and costly field drainage systems characteristic of Jamaica and Trinidad for example are not needed, and it is rarely elsewhere than in low lying flats, that natural drainage has to be supplemented. The rainfall averaging about 41 in. per annum in the sugar belt is low in comparison with other places not dependent on irrigation, but the cane displays remarkable vigour and sugar yields are good. South of the Tugela River which is the southern boundary of Zululand, most of the cane, both plants and ratoons, is cut after 16 to 20 months' growth. North of the Tugela, plant crops are reaped at 14 to 18 months, and ratoons at 12 to 14 months. It was recently stated that there is an increasing tendency to average two crops in three years, as compared with three crops in four years in other countries. In most areas there is a severe check to growth during the cool or winter season, from June to September. A great advantage is the long milling period extending to nine months.

Soil conservation

Contour planting is the general rule, a system which provides a highly important safeguard against erosion, and greater convenience for harvesting and transport. Soil erosion is a gravely serious problem in South Africa, and the protective qualities of sugar cane are well appreciated as a contribution to soil conservation. The land is left unprotected by a growing crop for as short a time as possible between the reaping of the last ratoon and replanting with cane. During this period green manure crops are grown and ploughed in. The principal legume used for this purpose is Sunn Hemp (*Crotalaria juncea*).

Irrigation

During recent years irrigation has been introduced in some areas. The Natal Estates own the most extensive system, covering 12,000 acres. Water is taken from the Umgeni River and lifted by six 600-h.p. five-stage electrically-driven rotary pumps to a height of 498 ft., through a pipe 3 ft. in diameter and 1,000 ft. long, being delivered to a concrete main canal 14 miles long. The pumps deliver a total of 42 cusecs or 943,500 gal./hour. There are, in addition, subsidiary pumps taking water from various streams, and providing an additional 31 cusecs, equivalent to 696,400 gal./hour. Electric power is generated by a 9,000-kW. plant at the sugar factory. The distribution system includes secondary concrete canals, cement-plaster subsidiary canals with wire-netting reinforcement, asbestos-cement pipes and inverted syphons. There are 39 dams or reservoirs with capacities ranging from 3,000,000 to 250,000 gal. These are used to impound water sumped during the night, as actual irrigation of the land is only carried out during daylight. During irrigation periods the pumps run continuously.

To those accustomed to irrigation works on flat lands, the application of large volumes of water to cane by surface methods in rolling country with steep hillsides is rather startling. Great care is taken to keep the water under control at all times, and to prevent erosion. Measurement is made at every take-off point on the main canal, using rectangular weirs, and at other places. Filter mud is applied to the land through the medium of the irrigation water. At various convenient spots on the tramway system there are mud or ' scum ' chutes below the track into which special rail-cars discharge the material into swiftly running water. The floor of the steeply constructed chute contains projecting hard rocks to break up the masses of mud as it is water-borne to the fields.

In other districts overhead irrigation is used to a limited extent, but it appears that the need for further investigation into rates of application, costs and financial returns is recognised before any extensive development of this method can occur.

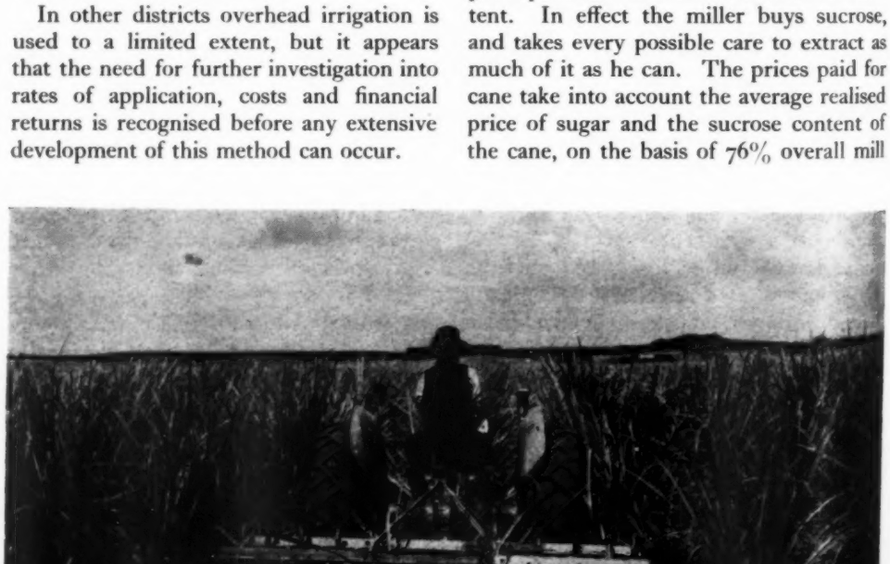
Cultivation

Field operations are highly mechanised. The uncertain and apparently diminishing supplies of agricultural labour have stimulated interest in the use of machines, some of which have been designed and built locally, such as mechanical cane planters. Tractors range from heavy-track type to light-wheeled machines with corresponding variation in implements. Attention is being devoted to mechanical reaping. A prototype machine capable of working on sloping land has been constructed and tested. Mule-drawn light implements are largely used for weeding and inter-row cultivation after the cane has become established.

Milling

During the first period of the industry's existence each cane estate had its own small mill. This phase gradually developed, particularly during the years 1890 to 1905, into centralisation of manufacture with an increasing proportion of cane supplied by farmers having no mills of their own. The position today is that farmers produce two-thirds of the total crop, selling their cane to the miller-planters who grow the other one-third. In the latter class the co-operative mill at Umfolozi may be included. During the 1950 crop 22 mills were in operation.

The basic consideration in assessing the price paid for the cane is its sucrose content. In effect the miller buys sucrose, and takes every possible care to extract as much of it as he can. The prices paid for cane take into account the average realised price of sugar and the sucrose content of the cane, on the basis of 76% overall mill



Weeding and inter-row cultivations are carried out with the help of light tractors

Rolling fields of Natal sugar cane grown near the sea

extraction, being determined under periodic agreements negotiated between the millers and the farmers through their respec tive associations. The final amount paid includes a standard price per ton of cane calculated in accordance with the agreement and supplementary sums to growers of 1,000 tons and upwards determined by a formula which provides for diminishing total payments per ton with increased output. This arrangement takes into account the fact that large-scale production costs are lower, while it is recognised that it is desirable to encourage the smaller growers, who make important contributions to the general prosperity by assisting mills to operate more nearly to full capacity.

Price determination

It is interesting to note how this method of price determination works out in practice. The standard price of sucrose operative at all mills for the 1950-51 crop for all varieties (of sugar) was £10.24447 per ton. In accordance with the agreement, this is equivalent to a standard price per ton of cane of 14.20% sucrose of 29s. 1.13d. A grower supplying 5,000 tons of cane with this average sucrose content would receive in addition to the basic price, 2s. 6d. supplementary rate, 9.88d. equalisation fund and 5.97d. flat rate per ton—a total of 32s. 11.98d. per ton. If the cane supplied was 15,000 tons or more, the addition to the standard price would be the flat rate only.

The European growers or farmers form the South African Cane Growers' Association, 720 members of which supplied 3,170,706 tons of cane to the mills in the 1950-51 crop, an average of 4,404 tons per grower. There are also non-European growers who delivered 434,408 tons.

Sugar recovery

The overall recovery by the mills, that is the proportion of the sucrose in the cane recovered in the manufactured sugar, is high, the general average for the 1950-51 crop being 83.65%. Juices generally are difficult to clarify. The sulphitation process is used, the allocation of sulphur for the industry for the 1951-52 crop being 7,000 tons. Lime consumption is very high in comparison with the West Indies, amounting to 7 lb. or more per ton of cane.

Almost the whole of the sugar produced is reserved for consumption within the Union. Industrial requirements for secondary manufactured products are large. The types of sugar made at the mills comprise refined, mill white, No. 2 grade (a high-polarising direct-consumption raw sugar) and refining raws. There is a central refinery in Durban equipped to produce upwards of 180,000 tons of refined sugar a year.

By-products

The processing of the by-product, molasses, is undertaken by separate manufacturing organisations, which, though dependent upon the sugar industry for raw material, form no part of it, but fall into the class of chemical industries. The principal products are ethyl alcohol of various grades—pure and commercial anhydrous, industrial and methylated spirit, and anaesthetic and industrial ether. A motor fuel known as Union spirit, consisting of anhydrous alcohol and petrol in equal proportions, is a popular product of one distillery near Durban. Another, using closed vats for the fermentation process, prepares solid carbon dioxide, which is sold in compressed blocks weighing 50 lb. to bottlers, who in turn dispose of the gas in steel cylinders to manufacturers of aerated waters, and to ships for use in refrigeration plants. Molasses from the refinery at Durban is railed over 400 miles to Germiston, near Johannesburg, where it is processed into ethyl and butyl alcohols and other products. Coal is used as fuel in the distilleries.

Two distilleries, one of them in Durban, recover potash from the dunder or waste liquor. The dunder is passed slowly through settling tanks where it deposits most of the suspended matter. The liquid is evaporated in a triple effect to a density of 46° Tw. and finally in a vacuum pan to 60/70 Tw. At this concentration the material can be ignited, and burns freely with the generation of considerable heat. The concentrate after burning is cooled, ground to powder, and bagged in paper bags. It contains about 37.5% K_2O, and is sold to the fertiliser trade. The sludge is pumped from the settling tanks, limed, filtered through a plate and frame press and dried, the liquid being sent to the evaporators. The dried material is powdered and also sold as a fertiliser.

In another distillery the sludge is filtered in a similar manner, dried by a rotary steam drier, and disposed of as a stock food.

Cane varieties

From the earliest days of the industry the subject of cane varieties has been of vital importance. Its establishment with imported varieties developed into a period during which the China cane, of unknown origin, was predominant among some 50 varieties introduced by the Government in co-operation with farmers' associations. Smut disease became serious, and in the '80s the ' Uba ' cane, brought in with others, proved so vigorous and free from disease that it rapidly became the principal cane grown, despite other unfavourable characteristics. Although the search for better types continued unremittingly, Uba retained its position for a great many years.

In 1902 the Natal Department of Agriculture, realising that it might be necessary to replace Uba, made numerous importations from various places. A system of plant quarantine became effective in 1913 to protect the rapidly growing industry against introduced disease. A few years later Mosaic disease, which had caused grave damage in other countries, was

recognised in Natal, only Uba being free. This further stimulus has contributed to the present variety outlook. In 1923 the South African Sugar Association decided to set up its own research organisation, which was established at Mount Edgecombe in 1925, with the principal object of introducing and testing new varieties of cane in a scientific manner. The work of this station has been a major contribution to the progress of the industry in many ways, particularly in regard to improved commercial varieties.

The need for greater care in effecting importations of new varieties became apparent and, in 1925, a quarantine glasshouse was built in the Botanic Gardens, Durban. All imported canes are grown there for two generations, being then released to the Sugar Research Station if they have not displayed symptoms of disease.

Cane breeding

For several years the experiment station used imported plant material which had passed through the quarantine station for all its varietal investigations. The range of suitable new canes available was, however, so restricted that cane seed (fuzz) was brought in and large numbers of seedlings grown for selection. At that time local breeding work could not be conducted because canes in Natal did not produce seed though they flowered freely. After close study this was found to be due to the non-development of the pollen, which, though present, was incapable of fertilising the female flower. Research revealed that the limiting factors were temperature and humidity, and that when these were maintained between the most favourable limits controlled crossings could be successfully made.

This work was done on a considerable scale with improvised arrangements for securing the necessary conditions and, as a result, a large glasshouse divided into compartments, each of which is under independent humidity and temperature control, has been erected and equipped. Whole canes to be used for breeding are cut when the commencement of arrowing —the formation of the flowering head— can be recognised. They are surrounded near the bottom with a metal cylinder packed with rotted cane trash, which is kept moist, and put into a compartment with the cut ends immersed in a very dilute solution of phosphoric acid and sulphur dioxide. Under these conditions the canes form new roots in the zone surrounded by the cylinder and continue to grow. Temperature and humidity are automatically regulated. In due course the male flowers develop pollen and crossings are made in the compartment. The subsequent stages of sowing, planting, testing and selection are closely similar to those practised in Barbados and elsewhere. In 1950, 40,000 seedlings were produced in this manner.

Final selections are released for commercial planting after being approved by the Department of Agriculture, and the publication of a notice in the *Gazette*.

The position in regard to commercially grown varieties has completely changed during the past 25 years. The overwhelming predominance of Uba has given place to Coimbatore varieties introduced as cuttings, which in turn are being abandoned in favour of N: Co. 310, a cane raised in Natal from fuzz which originated at Coimbatore.

Provision for research

In addition to the work described, which is conducted by the botanical division, the experiment station includes divisions of agricultural chemistry, plant pathology, entomology and agronomy. Headquarters are at Mount Edgecombe, where there are extensive well-equipped laboratories and glasshouses, with offices, library and staff residences, on 100 acres of land mainly devoted to the growing of seedling canes. At Chaka's Kraal, 20 miles to the north, the station has a 200-acre farm where the testing and propagation of promising seedlings are carried on and plantings made of final selections for commercial distribution. Because of the rapidly expanding work, it has become necessary to obtain 300 acres of additional land for the growing of these final selections on a much larger scale so that greater quantities of plant material of approved new varieties can be made available for planters, who will pay for it at a fixed rate per ton.

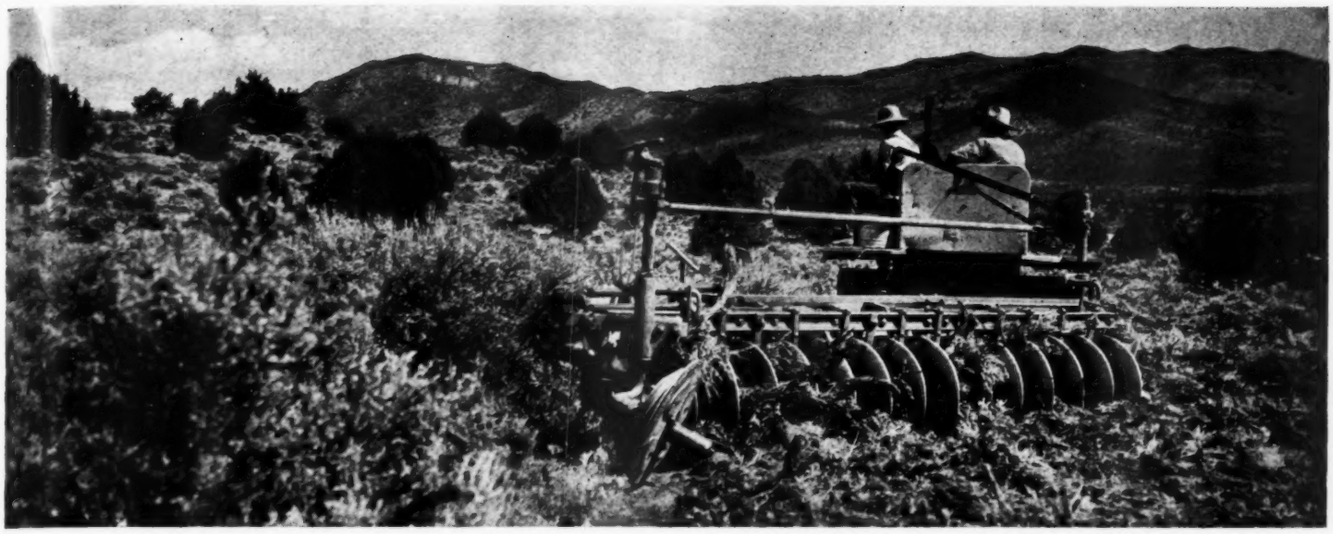
In June 1951 the foundation stone was laid of the laboratories for the Sugar Milling Research Institute, established in 1949. This institution is jointly financed by the South African Council for Scientific and Industrial Research and the Natal Sugar Millers' Association. Its work is to investigate milling practice and to conduct research on problems of cane sugar extraction processes in Natal.

Organisation of the industry

The industry is composed of numerous groups having their interest in the prosperity and progress of sugar production, but in some instances with divergent views. The whole organisation with its various associations provides for full discussion and consideration of all problems, and for the settlement of differences by agreement wherever possible, or if not, by the decision of an independent umpire. Each section has its own representative body linked directly or indirectly with the South African Sugar Association, which is in effect the central government of the industry. There is complete regulation of production by a quota system. This and other controls, such as statutory agreements relating to prices paid to farmers, are effected under the provisions of the Sugar Act.

Photos: South African Sugar Association.

The Darnell sugar mill. Twin sulphitation towers to the right



Sagebrush makes a large contribution to fodder resources in the United States, the U.S.S.R., Turkey and Transjordan. Here in Utah, a stand is being broken up prior to seeding with grasses

The Assessment of Fodder Resources

R. O. WHYTE, Ph.D., B.Sc.

Growing world populations render more and more insistent the problem of future food supplies. It is now apparent that we require to know what are the actual and potential productions of the various regions of the earth if we are to face the future with any degree of assurance. Consequently, methods of assessing these are of great importance. In this article Dr. Whyte discusses the assessment of fodder resources upon which animal industry depends. The author is already well known to readers of WORLD CROPS. *He was for many years Director of the Commonwealth Bureau of Pastures and Fodder Crops and has recently taken up a post under FAO in connection with the survey of world fodder resources which that organisation is undertaking.*

UNDER the stimulus of national planning movements, technical aid projects and international agencies such as the Food and Agriculture Organisation (FAO) of the United Nations or OEEC, a number of assessments have been and are being made of the natural and economic resources of various countries and regions. When these surveys refer to measurable crops, it is possible, provided adequate basic data and information are available, to present a reasonably accurate picture of the situation. It is, for example, relatively simple to assess acreages and total present or potential yields of wheat and other cereals, cotton and other fibre crops, sugar beet and sugar cane, and the various oil-producing crops, when these are already an important part of the crop pattern of the regions in question.

The task is not nearly so simple, however, when one comes to assess the total present and potential resources of fodder upon which the animal industry of a particular region is necessarily based. If we include under the general term ' fodder ' all types of animal feeds, whether obtained by grazing and browsing, or fed to livestock in the stall, the complexity of the task can be readily appreciated. One has to consider enclosed pastures, open grasslands and the many types of shrub and scrub associations which are used by grazing and browsing animals, the cultivated fodder crops, and the small grain, pulse and oilseed crops which provide the concentrated portion of the rations.

The objective

The theoretical objective should be to compile some kind of rough balance sheet of demand and supply, with the livestock population and its needs in terms of protein and starch equivalent on the one side, and the various available sources of fodder on the other. There are, however, so many imponderables, that any rigid statement of the position can rarely be attempted. In Great Britain itself, a statement of this type compiled at the beginning of the second world war indicated that a proportion of the livestock population would have to be slaughtered to make way for an increase in the arable acreage; actually, however, more livestock were kept in the subsequent years than previously. This was due to the relatively new factor of the steady improvement in the standard of grassland husbandry and the extension of ley farming which led to greater production from a smaller acreage of cultivated grasslands and the improvement of rough grazings.

Some attempt must nevertheless be made to assess the nature and size of the demand. For this, one requires to know the number, the type and the production of the various animals both at present and under any proposed scheme of development. The nature of these demands will differ widely according to whether one is considering a dairy industry, a rearing and fattening

industry, or one for which animals are kept primarily for their wool, hair or hides, or to act as beasts of burden or traction.

The nutrition chemist has to be called in to calculate the total daily or periodic requirements for these different grades of livestock, and for the many breeds within each group, with their variable demand for nutrients. He should be able to state the requirements for maintenance and production, and to translate these into terms of high- and low-protein fodder, roughages and the various forms of conserved fodder (hay, silage and dried green crops). Such a generalised calculation may be reasonably easy in a country such as Great Britain or the U.S.A., in which experimental data on nutrient requirements are readily available. It is not so simple when considering the many different types and grades of domestic animals met with under, say, African or Indian conditions.

Deforested hill country in process of conversion to grass: 14 million acres have been cleared in New Zealand

The problems

The first question is to what extent can the natural vegetation, cultivated crops and available home-grown or imported concentrates in the region under survey meet the existing demand or any potential increase in it?

The first step in supplying an answer is to review the existing management of the natural vegetation in relation to the conservation of soil and water. It is necessary to ascertain whether the present utilisation is on the basis of diminishing natural resources, or whether it is in equilibrium with the correct and optimal degree of conservation. In doing this the plant ecologist must consider the past history of vegetational changes, and to what extent the existing cover represents a form of degradation of natural ecological climaxes. In association with the soil specialist, he must decide how far continued and extended grazing is likely to aggravate deterioration of natural resources.

Assessment of resources

With this basic information available, the most difficult part of the survey has then to be faced, *i.e.* the assessment of the existing and potential fodder resources of the region. Fodder resources derive from two major sources, *i.e.* natural vegetation and cultivated land. It is appropriate here to draw attention to the way in which the grassland and pasture outlook of Great Britain, New Zealand and other 'grassy' countries has tended to dominate the approach to the problem in other countries in which herbage swards of the humid temperate type make little or no contribution to the total fodder resources. It seems desirable to regard the provision of animal fodder as a problem in itself, and to consider every source from which the livestock can obtain their fodder requirements —the natural plant association of grasses, herbs, shrubs and even trees, the arable crops cultivated for feeding and products and by-products of other forms of cultivation, such as the various cereals, grain legumes, oilseeds and similar crops.

The first step in assessing the utilisation value of natural vegetation, whether grassland, shrub, scrub or savannah, is to survey its botanical composition in terms of dominant and other species, and the present degree of utilisation. One can then attempt some grouping of ecological associations into range, veldt, steppe, pampa and so on, and begin to evolve management practices which will favour optimal use of and production from each type.

Applicability of existing techniques

All grassland specialists are familiar with the techniques of botanical analysis for the detailed study of humid temperate pastures. These methods are, however, not applicable to the wide open spaces of the world where areas are great, and staff and other facilities restricted. Ground reconnaissance methods, possibly combined with aerial survey and photography, are more useful under these conditions for making general phyto-geographical maps. Workers in the U.S.A., Africa, Australia and other countries have evolved techniques for such macro-surveys, thus giving an applied or practical turn to the work of the plant explorers and phyto-geographers who have mapped vegetation from their own particular angle.

Scope for vegetational surveys

A vegetational survey indicates the grazing load which the land can carry, and the extent to which existing resources require to be replaced or supplemented by arable fodder crops or conserved fodders. Before considering the arable land the next step is to ascertain the pattern of the use of the uncultivated and cultivated land and whether grazing and cultivating economies are separate, or are linked in some kind of farming system. For example, the relationship between the use of the low valley lands and hill lands in Wales, Switzerland and New Zealand; the century-old conflict between the free-ranging semi-bandit graziers and the settled cultivators in the Mediterranean region; or the recent studies by Dr. J. W. Rowland and his colleagues in South Africa on the correct relationship between cultivated farmland and uncultivated grassland. Knowledge of this sort helps to indicate the extent to which the border of marginal zones between the cultivated and uncultivated lands can make a major contribution to fodder resources.

This leads to consideration of the cultivated land itself, and of forms of alternate husbandry in which animal fodder is produced in rotation with cash and other crops. Here we have a wide range of temporary 'leys,' of varying duration and composition, ranging from the short-duration leguminous crop of the winter rainfall zones to the long grass leys of the U.K.

Uses and limitations of leys

The costs of cultivation, seeds and fertilisers make leys more expensive than

Bluebush, together with saltbush, makes a great contribution to the fodder resources of Australia

grazing or browsing unimproved natural grasslands. They must therefore be linked with a higher form of animal husbandry capable of giving a profitable return on the capital invested. Here, however, one has to take into account the effect of the animal population and the grass and legume species grown on the fertility of the soil, and on the yields of the fodder conservation crops subsequently grown in the rotation.

The cultivation of arable fodder crops usually entails fodder conservation, to ensure that high-quality forage is available over a maximum period and during times of drought, cold or other adverse conditions. On the method of conservation depends the amount and quality of fodder which will be available. Haymaking provides bulk with low quality; ensilage gives bulk with low quality or less bulk with high quality. Artificial drying should, but rarely does, give average bulk with consistent high quality. Home workers have indeed proposed the artificial dehydration of the great flushes of growth which occur at certain seasons in the tropics, but this does not take into account the high capital cost, the very short and so uneconomic duration of the season of maximum growth and the low inherent ' quality ' of the herbage.

Fodder crops

In reviewing ' crops ' which can be cultivated for animal fodder, one has to consider types which appear strange to the ley farmer of the humid temperate lands but which make a very considerable contribution to the total fodder resources of countries with more critical environments for plant growth. This class includes fodder trees, spineless cactus, fodder melons, olive prunings and so on, which are often invaluable in critical periods.

To illustrate the range of variation in conditions which may be met we may cite as examples the Mediterranean area and New Zealand.

Mediterranean conditions

In 1945-46 the author attempted to make a generalised over-all survey of the fodder resources of the island of Cyprus. Although no figures of actual carrying capacity of the natural maquis and other ' Mediterranean ' types of vegetation were available, it was obvious that it was carrying too many head of livestock, especially goats, to permit it to perform its duty of conserving soil and water properly. On the other hand, the arable land lacked fertility, as the animal droppings were spread by the free-range grazing system in small quantities all over the hills where they could have little effect before being washed or blown away.

So, with little hope of its being carried out because of the land tenure system and other adverse factors, it was recommended that more annual leguminous forage crops should be grown in the cereal/fallow rotation in the arable land, in order to rest the hills from excessive grazing and browsing and to bring fertility to the arable land, provided the forage crops were used correctly and all animal droppings returned to the soil. In the extreme Mediterranean environment of the Cyprus lowlands it is most difficult to produce a uniform level of animal fodder supplies throughout the year.

At present the grazing and green fodder resources of the Mediterranean region are being surveyed by a team of experts under the auspices of FAO and OEEC and it will be interesting to see how far the principles set out above are applicable in other parts of this area.

New Zealand

New Zealand is unique in relying almost wholly on pasture growth for dairy production, and has already gone a long way in the maximum development of this fodder resource. During the period 1920-40, the number of dairy cows in the three main dairying areas (Taranaki, North and South Auckland) increased from 105 to 239 per 1,000 acres of ' sown ' grass. ' Sown grassland ' in New Zealand includes hill country on which the seeds have been sown in the ashes of forest fires without cultivation; dairying is confined to the ' cultivated ' grassland where the cow density would be at least twice the figure shown above.

Over the same period, the area of supplementary crops fell from 277 acres to 42 acres per 1,000 cows, and the area from which hay and silage were prepared increased from 124 to 214 acres per 1,000 cows. In these three districts, 34% of the sown grassland was top-dressed with either lime or fertiliser in 1930, and by 1940 this figure had increased to 47%.

The production per acre of nutrients from New Zealand pastures is high. Yields of 10,000 to 12,000 lb. of dry matter per acre are not uncommon in experimental work, and ordinary dairying pastures show yields of 4,500 to 11,000 lb. of dry matter per acre per annum. These yields are confirmed by the average butterfat production per acre for the whole of the dairying land in the Dominion of over 100 lb. of fat, and yields of over 200 lb. of fat per acre used for dairying are not uncommon in intensively farmed areas.

Workers in the dairy industry will be familiar with W. M. Hamilton's classic review of the dairy industry in New Zealand (*C.S.I.R. Bulletin* 89, 1944), from which the foregoing data are taken. Hamilton expresses the view that expansions of dairy production might be possible in the following ways: (*a*) By more intensive farming of areas at present used for dairying; (*b*) by diversion to dairying of land at present used for fat-lamb raising or the fattening of beef cattle; or (*c*) by development of land at present lying idle but capable of being utilised for dairying.

In spite of the more intensive use of existing land already achieved during the period 1920-40, Mr. Hamilton considered that ' there is no reason why an increase of 50% in production from the area at present

Permanent pastureland, Montrose, Pennsylvania

devoted to dairying should not be achieved in a comparatively short period, say, ten years.'

Conditions in India

To illustrate yet another aspect of the question we may briefly discuss the position in India. The Indian subcontinent presents an entirely different set of conditions to those previously considered and the existing stage of development is much more primitive. Under the simulus of the plan for the development of Indian agriculture and animal husbandry put forward by the Advisory Board of the Indian Council of Agricultural Research about 1946, several workers have attempted to assess the existing fodder resources and to indicate how shortages might be overcome. In such a country, the continually increasing demand for cereal foods for human consumption is so great that there is little room left for expansion in animal fodder production. In order to achieve national sufficiency in human foodstuffs, the minimum targets are to increase the existing production of cereals by 10%, pulses by 20%, fats and oils by 250%, fruits by 50%, vegetables by 100%, milk by 300% and fish and eggs by 300%. The increased output of milk and greater outturn of work by working animals envisaged under the plan would require a 400% increase in oilcakes and other concentrates and a 55% increase in roughages.

One reviewer (L. C. Sikka) estimates the total requirements of India's bovine stock for milk, work and growth to be:

	Tons
Digestible protein ..	14,294,600
Starch equivalent ..	108,380,000

The present supplies of roughages (fodder crops, grasses and straws) and concentrates (oilcakes, excluding castor, brans, pulse husks and *chuni*, and cottonseed) provide only 42.7% of the requirements of digestible protein and 56.6% of the starch equivalent.

Once again it becomes necessary to assess the actual and potential contribution of the uncultivated and cultivated lands to the total fodder resources, in order to decide the best course for future policy in such a competitive state of land use.

Conclusion

Conditions under which animal fodders are produced are so diverse that the methods of approach to an assessment must be equally varied.

As the various countries of the world come to realise the importance of the problem and make a start with the production of data, it should become possible to fit the pieces of the jigsaw puzzle together and to obtain an increasingly accurate picture of the actual potential production of animal products in the various regions and the relationship it bears to the production of other forms of agricultural produce (crops, etc.). In making such an assessment, however, it is always necessary to bear in mind the overriding need for ensuring optimal conservation of the vegetational cover (either in the form of crops or natural vegetation), since on this depends the conservation of the soil and water resources essential for human existence.

European Conference on the Organisation of Agricultural Research

At its second meeting in Geneva in March 1950 the European Committee on Agricultural Technology of FAO considered the problems of agricultural research in Europe. They expressed the view that there was need for co-ordination of the activities of the various organisations concerned. At present the facilities and personnel needed to carry out agricultural research in Europe are too limited to meet all the demands and it is accordingly very important that the existing provisions should be used as efficiently as possible. This can only be secured if unnecessary duplication of work is avoided and research so organised that the efforts of the various workers and laboratories will supplement each other and contribute to the solution of common problems.

It was recommended that a conference should be convened by FAO to discuss the problems and administration of agricultural research in Europe and a steering committee was set up by FAO to implement this recommendation. As a result an International Conference will be held in London, between October 15-18, 1951, to discuss the whole matter.

As a preliminary a questionnaire was drawn up and sent to the Governments of member countries in Europe, and from the replies a document has been prepared which will provide the basis for the discussion at the Conference.

The agenda for the conference falls under the following heads: (a) a review of the present organisation of agricultural research in Europe; (b) organisation of agricultural research on an international level; (c) collaboration in research on an international level.

The Government departments which control agricultural research may include not only Ministries of Agriculture, but also education and other government departments.

Funds for agricultural research may be derived exclusively from public finances; or they may be provided in part from private sources.

In some countries, there is a central body which co-ordinates agricultural research, but the powers differ widely in different countries. In others there is no central co-ordination at all and much of the research is uncorrelated to parallel activities in the same area.

Obviously the position is confused and if the projected conference succeeds in establishing some degree of correlation of agricultural research on a European basis it will have accomplished a task of high importance.

Potato Silage in Holland

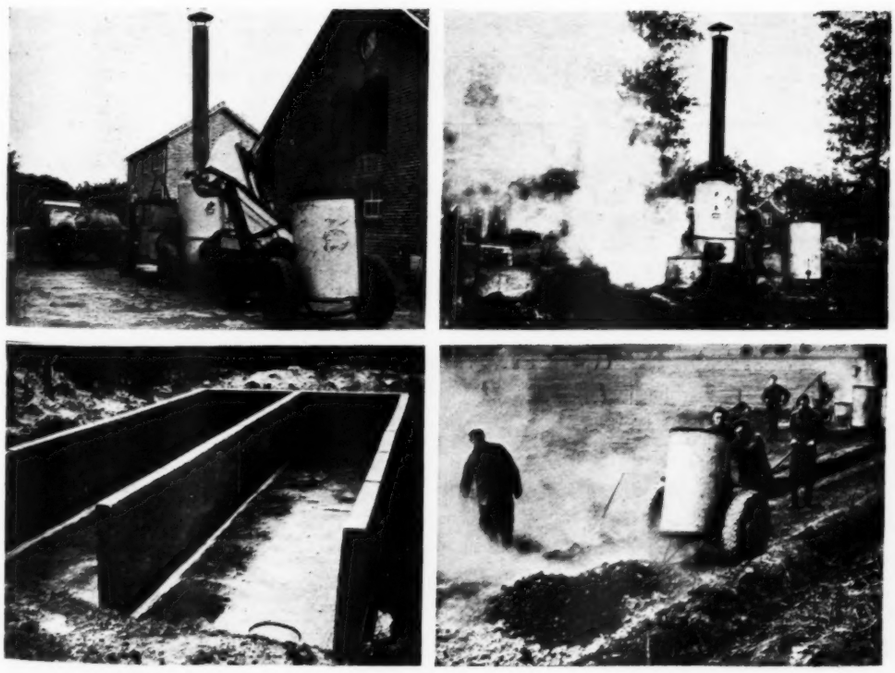
Dr. TJALLING BAKKER

Agricultural Attaché, Netherlands Embassy, London

The use of potatoes as material for ensilage is attracting increasing notice. In the Netherlands ensiling potatoes has extended rapidly of late years. Potatoes need to be precooked if the best results are to be obtained. Here, an account is given of the current procedures in making ensilage from potatoes.

THE time is long past when unlimited quantities of concentrated feeding-stuffs could be purchased at a very low price. All Governments of Western Europe have read the signs, and are urging farmers to grow more feeding-stuffs at home in order to become more self-sufficient and make more currency available for other purposes.

During the war and under post-war conditions Holland has travelled far along this road, and the present position is that the same amount of milk, more pigs, and 75% of the number of eggs are being produced with about one-third the pre-war quantity of imported feedingstuffs. This has been achieved to a large extent by more intensive grassland management, and better preservation of the grass as artificially dried grass, silage and high quality hay dried on tripods. Thus, a considerable amount of protein has been produced. Calories, however, are just as important and an increase in starch equivalent has been obtained by growing fodder beet and potatoes. The crop which gives the highest yield in terms of calories is sugar beet, and if we assume this to be 100 then the corresponding return for potatoes is 80 and that for cereals is 50, all calculated on a dry weight basis. These crops, however, are not interchangeable for all classes of livestock, and to produce starch equivalent for pigs and poultry, potatoes are the ideal substitute for grain. The agricultural advisory services in the Netherlands, therefore, recommend an increase in the acreage of potatoes for stock feeding.



(*Top left*) **Mobile potato steamer with potato washer ready for transport.** (*Top right*) **The steamer at work.** (*Bottom left*) **Twin concrete potato silos.** (*Bottom right*) **Tipping a drum with steamed potatoes into an emergency silo.**

Need for cooking potatoes

Potatoes can only be used for stock feeding with fully satisfactory results if they have been previously cooked or steamed since, and especially for pigs and poultry, raw potatoes have a relatively poor feeding value. There is, however, relatively little difference in feeding value between freshly cooked or steamed potatoes and potato silage.

When potatoes are fed fresh, losses in dry matter of the order of 30% to 40% and more occur in the stored raw potatoes between October and July. These losses are due partly to respiration and other processes of the living plant, and partly to heating in the clamp, frost damage, rotting, etc. On the other hand, the losses in dry matter by ensiling steamed potatoes are only between 5% and 10% in well made silage. It is, therefore, advisable to steam and ensile all potatoes intended for stock-feeding early in the autumn.

Installations for steaming potatoes

This is done on a large scale in Holland, for which specially constructed mobile and fixed installations are used. The mobile unit consists of a steam unit and four large drums, each with a steam valve, for the cooking, and a potato washer ; often a potato crusher is also provided. After the potatoes have been washed, a drum or set of drums is filled, the lid screwed tight and steam under pressure let in ; after 10 min. the steam is cut off and coupled on to the next drum or set of containers. After a further period of about 20 min. the potatoes in the first set of drums are cooked, and using a pair of detachable wheels the drums are brought to the silo, the potatoes dumped and rammed tight to exclude the air. Each drum holds 790 lb. potatoes, and each set 1,580 lb. These steamers work with a pressure varying between 0.2 and 0.4 atmospheres (2.9-6.9 lb. per sq. in.)

It is important that the potatoes should be free from soil when they are put in the silo, while rotten potatoes should not be present in any quantity. In case a clamp of potatoes is frozen, they can be saved for fodder by steaming and ensiling immediately.

The potatoes should be well cooked, as half-cooked potatoes have a poor feeding value for pigs.

In large plants the procedure is similar ; the potatoes are steamed in large containers and as soon as they are cooked they are transferred to lorries or trailers which carry them to the farms, where they arrive still warm and are tipped into silo pits.

Making potato silage

Potato silage can be made in concrete silos or in trenches. The concrete silo has the advantage that there is no contamination with soil and no loss at the sides. It is necessary to have a watertight silo when there is a possibility of water entering from the soil. A trench silo must be long and narrow, the width being such that a section of the trench can be cut off each day for feeding. The cut side of the silage must not be exposed longer than one day to the air, otherwise butyric acid fermentation will start and moulds grow. If a pit is used, the bottom and sides should be covered by sisalcraft paper, old paper bags, or even straw.

The steamed potatoes are put into the silo in layers, each layer being rammed home so that the potatoes are thoroughly crushed and no air pockets remain ; moulds start growing around air pockets and rotting may spread from these.

Many installations use a potato crusher which breaks the potato in about four pieces before it is cooked. Sometimes, a crusher is installed at the pit to make the work of crushing the steamed potato easier.

When the silo is filled it should be covered with sisalcraft or other paper or straw, and capped with a layer of soil about 1½ ft. thick. The quicker the pit or silo is filled the better. Lactic acid fermentation then takes place and after four to six weeks the silage is fit to be used as fodder.

Potato silage can be kept indefinitely, provided it is well covered with soil and rain water cannot penetrate into the silage. Once it is taken out the silage must be fed the same day, otherwise butyric acid fermentation will start and, especially in spring and summer, it may deteriorate quickly when thrown on a heap in a shed or barn. In winter the cut surface must be protected against frost, as frozen potato silage is harmful for pigs.

Feeding value

The feeding value of potato silage depends on the quality of the potatoes used. In general, four lb. of potato silage is equivalent to one lb. of barley meal.

Feeding tests with pigs have proved that more than half the cereal part of the ration can be replaced by potato silage. The rate of growth is the same as with meal rations, and the increase in live weight is the same per unit dry matter. The pork or bacon obtained with these rations is at least as good as that obtained with a suitable meal ration. The financial returns are of the same order if the price of a unit starch equivalent is assured to be the same in both cases.

This co-operative plant for washing and steaming potatoes has a capacity of more than 100 tons a day

Usually farmers start feeding potato silage when the pigs have reached a live weight of about 50 lb. A ration usually comprises 1 lb. of ground cereals, 300-400 grammes of a high protein concentrate or 3-4 litres of skimmed milk, and steamed potatoes or potato silage *ad lib.* As long as the mineral and vitamin content of the concentrate is adequate, no other food is necessary. Otherwise dried grass meal, cod liver oil and extra minerals may be required, or in summer fresh lucerne or other green stuff to balance the ration.

A considerable portion of the ration of breeding sows can consist of potatoes, provided fodderbeet, mangolds, lucerne, etc., are also given.

Steamed potatoes are more suitable for fattening than for milk production. Not more than 20 to 30 lb. must be fed per day

The steamed potatoes are mashed and compressed in the silo

to cows in milk. Fattening cattle can be given 60-80 lb. per day, provided that the ration is properly balanced.

Economics of potato silage

MOBILE STEAMERS

Cost per ton of Potatoes

	1949 fl.
30 kgs. of fuel	1.50
Engineer's wages	1.30
Repairs, maintenance, etc.	0.42
Depreciation of machinery (writing off machine in 5 years)	1.38
Other overheads	1.00
	fl. 5.60

(Note. A Dutch florin is worth about 1s. 10½d.)

To these costs must be added the washing of the potatoes, wages of farm labour, and moving outfit from farm to farm. No exact figures about these costs are known, but an investigation has shown that the number of man-hours per ton of potatoes put into a silo varies between $2\frac{1}{2}$ to $3\frac{1}{2}$; at a wage of fl. 1.00 per hour this adds fl. 3.15 average per ton of potatoes. The total cost (exclusive of washing and moving the outfit) works out at fl. 8.75 per ton of potatoes (roughly 17s.).

It is assumed that the outfit works for a period of three months with 60 working days ; at 12 tons per day this gives an output of 720 tons of silage per season.

Fixed plants for steaming potatoes

Capacity : 100 tons per day, working for a season of three months with 70 working days—7,000 tons.

	Cost per ton fl.
Fuel	1.50
Wages	0.60
Maintenance	0.20
Elevator and weighbridge	0.15
Depreciation	1.10
Rent	0.15
Electricity	0.05
Other overheads	0.10
	fl. 3.85

Included is the cost of washing the potatoes ; to be added is the transport cost from and to the farm. This works out at fl. 3.00 up to $5\frac{1}{2}$ miles, and fl. 6.00 per ton up to 14 miles. The average distance is $\pm$ 10 miles, and the cost of transport will not exceed fl. 4.00 per ton.

Total costs, therefore, are fl. 8.00 per ton (inclusive of washing). On economic grounds the installation of large potato steaming plants under Dutch conditions is somewhat more advantageous than working with the mobile units. At the time of writing increasing numbers of both types of installation are coming into use in Holland.

Photos: Netherlands Ministry of Agriculture

Virus Diseases of Crops in East Africa

The East African Agricultural Research Institute at Amani has now been absorbed into the larger East African Agricultural and Forestry Research Organisation. Among the many achievements of that institution none is more striking than the work carried out on virus diseases of certain crops in the East African region, under the direction of Dr. H. H. Storey, C.M.G., F.R.S., now Deputy Director of EAAFRO. Accounts of this work are scattered about in numerous reports and published papers. Recently the main accomplishments at Amani during the 20 years of its existence have been summarised by Dr. Storey in a short memoir which accompanied the recently published report on the work of EAAFRO for 1950 (reviewed elsewhere in this issue). From this the following account of Dr. Storey's work on these virus diseases has been extracted.

IN the original plan for research at the East African Agricultural Research Institute at Amani, Tanganyika, which has now been absorbed into the East African Agricultural and Forestry Research Organisation, plant virus diseases figured as the primary item of the work in plant pathology. The preceding decade had been one of expanding research on this group of diseases, particularly in America, and agriculturists had come to recognise virus diseases as seriously menacing production of many crops. An Empire Conference in 1927 had pressed for more fundamental research on them.

Streak disease of maize

Amani's chief contribution during the following years was a study of the fundamental relation between a virus, the plant in which it produced a serious disease and the insect that carried it from plant to plant. Streak disease of maize had been recognised in Natal before the end of the 19th century, but it was not until the work of Storey during the period 1922-27 that its virus causation was proved and the insect-vector found, a leaf-hopper *Cicadulina mbila*. On his move from Natal to Amani, Dr. H. H. Storey found both disease and insect prevalent in all East African territories. He brought to Amani, and developed there, original techniques for studying the virus-insect relationship. Foremost among these developments was a method for experimentally inoculating virus into this small insect and for transferring body-fluids from one insect into another, neither of which had been done by any previous worker. Prolonged studies on these and related lines threw new light on the transmission process and defined some of the conditions under which the insect would transmit the virus.

Accounts of this work attracted considerable interest among virus workers throughout the world. The methods developed have since been used not only by a few workers with plant virus diseases but also by at least one group of workers with an animal disease and a mosquito-vector.

These studies occupied the greater part of Amani's first ten years. They were essentially long-range research, for which immediate results of practical value could not be expected except by fortunate chance. Nevertheless, they added to our store of knowledge on a general problem, the great practical importance of which cannot be doubted. Furthermore, in the late 'thirties they were turned to use in the practical problem of breeding maize for resistance to streak.

Tobacco leaf curl

Certain work incidental to the main project proved to be of direct application. In the late 'twenties a curious type of leaf-curling had been observed in the tobacco of Southern Rhodesia and Nyasaland. By 1931 severe outbreaks had occurred and tobacco growers were becoming alarmed. The cause was unknown; one worker in Rhodesia had attributed it to direct damage by a plant-sucking bug, while others suspected a nutritional disorder. Authorities in Nyasaland were recommend-

ing nitrogenous fertilisers as a preventative.

It happened that Amani had studied a leaf-curl appearing there in tobacco and had proved it to be caused by a virus transmitted by a species of white fly. (Similar results had been obtained at this time in Java.) During a visit in 1932 to southern Rhodesia and Nyasaland, Storey identified their disease with the Amani one, and this identity was confirmed in experiments by officers there.

A means for controlling the disease now became evident. It is common experience that, after a tobacco crop has been reaped, self-sown seedlings and old stumps remain alive and continue in slow growth through the off-season. They were often diseased and infested with white flies. Here then was an obvious way in which the disease was carried over to the new crop. So in 1933 the Southern Rhodesia Government passed an Act requiring growers to uproot and destroy all tobacco plant stumps and seedlings at the end of the season. By 1939 it was possible for authorities to report that since 1933 no serious outbreaks of the disease had occurred except where growers had failed to carry out this requirement.

Control of a potentially dangerous disease had thus been simply achieved. The key to success had been the basic information provided by research. Clearly no progress could have been made on the incorrect assumptions that held the field before the Amani work.

Rosette disease of groundnuts

Rosette is a disease that causes serious losses in groundnut crops in many parts of Africa. Research by Storey (with Miss Bottomley) in South Africa had for the first time shown it to be due to a virus transmitted by a particular species of aphis. In 1931 the disease was causing considerable concern in Uganda. The chief outcome of a visit by Storey to the eastern province of Uganda in that year was recognition of the great influence that spacing exerted on the incidence of the disease. Africans' plots, where the traditional practice was to sow groundnuts broadcast at very close spacing, were often but slightly affected by rosette, whereas widely spaced plots nearby were at that time almost completely destroyed. It appeared that the African had by trial and error already discovered a means for escaping serious losses from this disease.

The Uganda Department of Agriculture was at the time carrying out spacing trials, and by concentrating observations on rosette incidence in these trials and others in following years, it obtained ample proof of the benefits of close spacing. This benefit has since also been realised in other countries, such as the Belgian Congo and South and West Africa, and it appears that the method of reducing losses by close spacing has a wide, if not universal, application in Africa. Nevertheless a satisfactory explanation of this effect still evades research.

Virus disease of cassava

The virus diseases of cassava early engaged Amani's attention. Mosaic was recorded towards the beginning of the century by German workers in East Africa, and since, in most parts of Africa and Madagascar. Everywhere it is recognised as taking a serious toll of this important food crop. Its causation by a virus and transmission by white fly had been previously suspected, but proof came from the Amani work.

Storey and Nichols proved that there was a group of diseases combined under the general title of 'mosaic,' and that the several viruses concerned varied in the severity of the ill-effects they produced. They showed that the white fly could successfully infect a plant only if it fed on the very young leaves. In the Amani District the spread of the disease was much more rapid in some months than in others, so that it was possible to choose an 'ideal' planting date which would permit of the cassava remaining healthy for the longest period of growth.

A second virus disease, previously unrecognised, was found to be prevalent in cassava-growing regions at low altitude. This disease, brown streak, can under some circumstances kill susceptible plants or render their tubers useless. In coastal regions it is often as important to the grower as mosaic disease.

The breeding of cassavas resistant to these two viruses was one of Amani's main preoccupations during its second decade.

For a start a collection was made of local varieties and, in addition, more than a hundred were imported from overseas. The results of field trials were to eliminate all but a few as being fully susceptible to mosaic disease. The few retained were not immune, but were markedly more resistant than the average.

As a first step, these selected resistant varieties were distributed widely for trial by Departments of Agriculture. In one area at least their substitution for previously grown susceptible varieties has had spectacular results. During the 'thirties, mosaic had been gradually spreading in the eastern province of Uganda until by 1941 it was realised that yields had fallen to an extremely low level. At about this time the selected Amani varieties came under trial in Uganda and immediately demonstrated their superiority. Distribution to growers began in 1944 and, by 1950, Agricultural Officers estimated that 63% of all cassava grown in the Teso District was one of the new varieties. The Department of Agriculture considers that the change has resulted in a sevenfold increase in the crops reaped.

Interspecific hybrids of Manihot

From the research point of view, however, this selection of resistant varieties had been only a first step. The objective was to breed new varieties that possessed much greater resistance than the best of the selections. It soon became evident that not much was to be gained from the simple crossing of the best of the true cassavas, although one of the Amani crosses of this type proved in some areas to be the most resistant true cassava we possess, though not to an extent that would allow of its being regarded as a solution to the problem. However, a number of other *Manihot* species were available, including the well-known Ceara rubber, *M. glaziovii*. Neither of these produces tuberous roots.

The programme of interspecific hybridisation is in its 13th year and is still being pressed forward by Nichols at Amani. It has been an immense task, involving the individual pollination of some 25,000 flowers and the raising, propagation and testing of over 7,000 seedling varieties.

Results have shown that high resistance can be conferred to the progeny of interspecific crosses, but that it required several generations, back-crossed to cassava, to restore the ability to produce tuberous roots of satisfactory quality. A first distribution of hybrids for trial was made to Departmental Stations in 1950.

Elimination of the two virus diseases in cassava must lead to a great increase in crop without any added effort by the grower. The stage is now reached where the basic research is nearing completion; the next stage depends on co-operative work between basic and applied workers in testing the new varieties in different regions and distributing them to growers.

MAIN RESEARCH PAPERS

H. H. Storey: 'The filtration of the virus of streak disease of maize,' *Ann. appl. Biol.*, 1932, **19**, 1.

H. H. Storey: 'The inheritance by an insect vector of the ability to transmit a plant virus,' *Proc. Roy. Soc. London*, 1932, B, **112**, 45.

H. H. Storey: 'Investigations of the mechanism of the transmission of plant viruses,' *Ibid.*, 1933, B, **113**, 463.

H. H. Storey, *Idem* II, *Ibid.*, 1938, B, **125**, 455.

H. H. Storey: *Idem* III, *Ibid.*, 1939, B, **127**, 526.

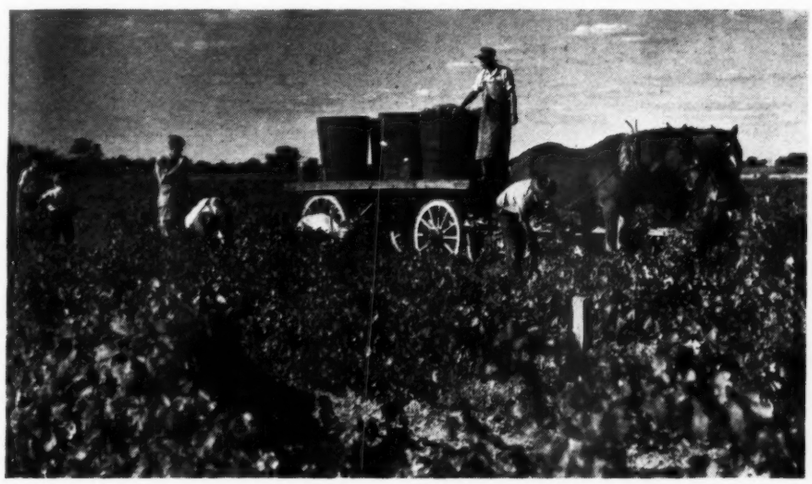
H. H. Storey: 'Transmission of plant viruses by insects,' *Bot. Rev.*, 1939, **5**, 240.

H. H. Storey and R. F. W. Nichols: 'Studies of the mosaic diseases of cassava,' *Ann. appl. Biol.*, 1938, **25**, 790.

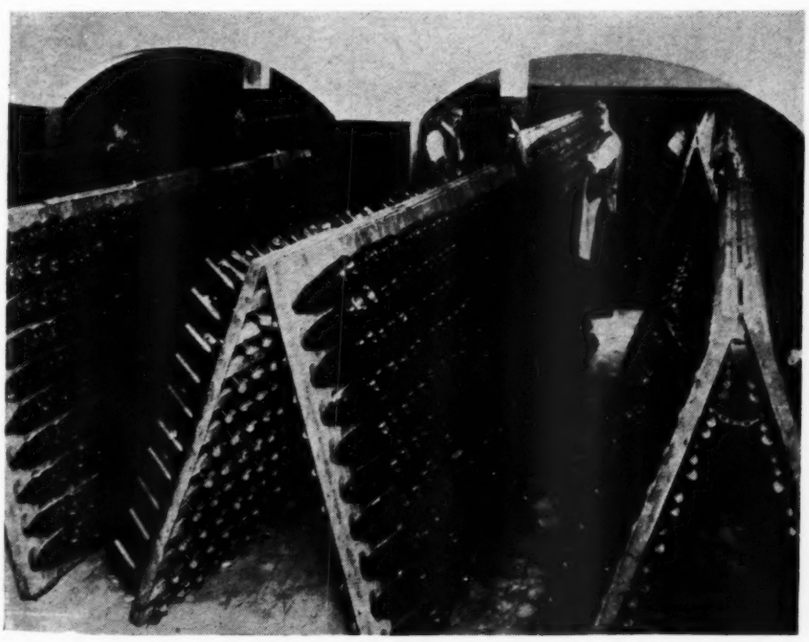
R. F. W. Nichols: 'The Brown Streak disease of cassava. *E. A. agric. J.*, 1950, **15**, 154.

Australia — Britain's Vineyard

It is a popular idea in Britain that wine production in Australia is a comparatively recent development, but its beginnings may be traced back to the earliest colonial days. Vines taken to Australia in 1788 were replaced by comprehensive collections of grape cuttings from Europe, the descendants of which, in many cases, are still producing wines of character. Repeated and systematic plantings, the evolution of sound and modern production methods, and the British public's enthusiastic reception of Australian wines have combined to encourage the development, especially during the past fifty years, of a vast and varied industry which is now confronted and partially paralysed, by the cul-de-sac conditions imposed by heavy British customs duties.



Grape pickers at Rutherglen, Victoria



Champagne bottles in the cellars of a South Australian vinery

FOLLOWING upon awards made for Australian wines at the Bordeaux exhibition in 1873, *Le Moniteur Vinconti* stated: 'If Australia were not too remote to become for a long time an exporting land for wine, its competition would alarm us. We fear that prejudice may operate as much as distance against the progress of Australian wines in competition with those of France and other European countries.'

For many years this forecast proved accurate; nevertheless, a growing trade in dry or beverage wines did develop up to 1924. Until then, with no preference in tariff, Australia was unable to export fortified wines in competition with European countries. The higher Australian production costs and wage levels, and the burden of cask-wood costs and shipping for the 14,000 mile voyage were finally offset in 1925 when the system of Imperial Preference gave Australian fortified wines a chance to compete with Britain's continental neighbours.

The effects were instantaneous—Australian wines became popular in Britain as modestly priced wines of a consistently high quality. By 1939 Australia was exporting to the U.K. 3.7 million gal. of wine per year—four-fifths of her total wine exports, Portugal alone heading her as a shipper of wines to Britain with a quantity only slightly greater.

The majority of wines are of the sweet, full-bodied type of a consistently clean quality, since the absence of summer rains gives almost total immunity from mildew and kindred diseases. Most of the vineyards are situated in the warmer, low altitude areas, but some are found in the higher and cooler districts where delicate dry white and red wines are grown.

Adaptability of the vine

The vine itself is a remarkably adaptable plant and will withstand a wide range of climatic and geological conditions, but the

world's major vineyard areas are usually found within a definite band in both the Northern and Southern Hemispheres. In the north the chief vineyards exist between 35°N.—representing the line through Algeria and California—and 50° at the Champagne area.

The most famous Australian vineyards are found between the same degrees of latitude south, from southern Queensland in the north to Victoria and South Australia in the south, and with the vineyards areas of New South Wales lying between these limits. From the Hunter River District of New South Wales come many of the finest dry white wines of Australia, from vines grown mainly in the valleys where the soils are deep and sandy and where the vineyards are sheltered by surrounding hills.

The varieties most commonly grown for white wines are the Semillon, Verdho, Ugni Blanc, White Hermitage, and to a lesser extent Clairette. In other parts of this district the soils are of a volcanic origin, weathered from ancient rock, and are particularly suitable for the production of red wines. Of these varieties the Syrah, commonly called Shiraz or Hermitage, forms the bulk of the plantation, while the Cabernet Sauvignon is used to a certain extent because of the quality it confers on dry red wines. Some Pinot, of both the black and red varieties, is cultivated.

Vintage usually commences in Australia early in February and lasts for about five or six weeks. The grapes are gathered by pickers and transferred to vehicles for cartage to the factory, where stemming is the first operation, the berries being separated from the stalks, crushed, and then conveyed to fermenting vats. Pure cultures of yeast are used to ensure clean fermentation, after which the young wine is pumped to the storage casks.

For the making of white wines the juice is drained immediately after crushing and is fermented apart from the skins in order to eliminate colour and skin-contributed characteristics. Red wines are fermented on the skins in order to produce the required density of colour.

Other wine producing areas

Since this New South Wales district has never been ravaged by phylloxera, many of the original vines are still growing upon their own stocks, some of them over 75 years old. The Hunter River wines, although light in alcohol, are soft and round, giving a false indication of body because they lack the high natural acidity of unbalanced fruit.

The Minchinbury vineyards, comprising some 250 acres of vines planted with red and white varieties, constitute one of the most famous wine cellars in New South Wales. Lying in well drained, undulating land, this vineyard, with its up-to-date winery, is one of the most attractive in Australia. The soil is ideal for the growth of light wines, and many of the finest white varieties are grown, ensuring that Minchinbury wines are of a very high standard, admirably suited to the production of sparkling wines.

This vineyard now supplies the greatest part of Australia's champagnes and many of its best dry white wines. On the other hand, the Hermitage, Alicante Bouchet, Cabernet Sauvignon, Pinot, and Durif varieties produce dry red wines of a character especially adaptable to Sparkling Burgundies.

Four hundred miles south-east of Sydney, in the region of the River Murray, the Corowa-Albury district takes in a large tract of country where rainfall and humidity are lower than in other New South Wales vineyard areas, but in which the summer temperatures are still consistently high. These climatic conditions, combined with the particular type of soil, make this portion of the State particularly suitable for the growth of rich sweet wines, some of which have shown a considerable degree of similarity to those of the Duoro.

With careful vintaging and given maturity, the wines of Corowa are distinguished for their softness and quality. Further south, several extensive wine-growing districts are found in the centre of one of the oldest and richest gold-producing areas of the country.

The major Victorian wine districts, Wahgunyah and Rutherglen, were badly affected by phylloxera in 1899 and had to be replanted with phylloxera-resistant stocks. The Rutherglen district now produces particularly rich and luscious sweet wines which, if the grapes are allowed to reach high maturity, are rather in the nature of a liqueur.

In addition to these red types, this same district produces other exceptionally fine sweet wines which always command high prices for the Australian trade.

For many years the Great Western District, on the overland route between Melbourne and Adelaide, has been associated with the wine industry through the efforts of the late Hans Irvine, who established the vineyards known as 'Great Western.' He was one of the first to undertake the manufacture of sparkling wines, and for the purpose built an extensive system of vaults for storage and maturing.

In South Australia, the areas under vines are far more extensive than in any other State. These vineyards have not been ravaged by vine diseases, and for many years the vignerons of this State have voluntarily taxed themselves to build a fund for mutual defence against a possible outbreak.

In the Central District of South Australia, on the slopes of the Mount Lofty Range, perfect grapes are grown. Natural rainfall is ample for the vine's requirements, and soil conditions have encouraged the planting of extensive and luscious vine, olive and almond plantations flanked by groves of oranges, peaches and apricots.

A section of the cellars where wines are stored ready for bottling

Vinery at Nuriootpa, South Australia

The wine of this district may be dry or sweet, according to the actual locality, the type of grape grown, and the period at which the fruit is gathered. However, since the usual summer climate is fairly hot and dry, the greater part of the grapes is used for making sweet wines. The soils generally are well drained, of a clay loam consistency, and in some cases mixed with shaly rock. The varieties mostly grown are the Shiraz, Grenache, Frontignac, Pedro Ximenes, Muscatel, Riesling, Cabernet and some Sweet Hermitage.

In South Australia's southern district, one of the country's earliest vineyards was set out by John Reynell in 1838 and is now incorporated in the famous Reynella vineyards. This southern country produces a considerable variety of fine light wines, many of which have high reputations on the British market, while other parts are famed for their full-bodied dry wines. The district has a good rainfall although the summer is fairly dry, and it is therefore possible to include sweet wines of high quality in the vintage by allowing the grapes to remain longer upon the vines. A good deal of the land has an underlying subsoil of limestone or marl, which is conducive to high percentages of sugar in the fruit for the production of sweet wines. The varieties generally grown are Shiraz, Mataro, Grenache, Riesling and Pedro Ximenes. Further back into the steeper hills, the Rhine Riesling is grown with success and yields fine light wines of special distinction.

Port type wines

In the northern areas of South Australia the weather and soil conditions combine to produce many of the finest port type wines made in Australia. Probably the most famous winery in the district, and one of the best known in Australia, is Seppeltsfield, established over 80 years ago. Seppeltsfield is one of the largest individual wineries in the world, handling thousands of tons of grapes each vintage season with modern plant of the very highest standard.

At vintage time the huge loads of grapes are transported by motor lorry from many of the smaller private vineyards to the local grape-buying wineries, where they are classified and processed. Vignerons do not make their own wines as in many European countries, but sell their grapes in sorted lots to the local wineries, many of which are co-operative ventures and communally owned. In addition to producing high general standard wines under uniformly modern conditions and according to all the ancient arts of the vintner, the wineries are also sufficiently numerous to ensure a constantly wide variety of wines and avoid the dangers of over-standardisation.

Considerable developments of the wine industry have occurred in Western Australia, but, as in the rest of Australia, it is relatively small compared with the scope of the country. The vine is successfully grown and good quality wines produced on many small vineyards, but most of it is sold locally. These small vineyards, within a short distance of Perth, also produce fine table grapes, currants and raisins. The greater part of Queensland is too close to the tropics to be of any use for viticulture. Development in southern Queensland will probably come with an expanded home and overseas market, but South Australia will undoubtedly remain the greatest and richest of Australia's wine-growing States.

The above article originally appeared in our sister journal 'Food Manufacture', June issue, 1951.

Photos: The Australian Wine Information Centre

Dutch Reclamation Project near Vancouver

The N.V. Verenigde Transatlantische Hypotheekbanken (United Transatlantic Mortgage Banks), Rotterdam, have recently taken the initiative in setting up a company with the task of reclaiming and exploiting an area of about 10 square miles in the Fraser Valley, B.C., close to the seaport of Vancouver.

In addition to the reclamation itself the project envisages the establishment of a farming school for young Dutch farmers and the renting of reclaimed land mainly to Netherlands' farmers with experience of Canada.

Since the war many Dutch farmers have gone to Canada because in recent years a new generation of 60,000 young farmers had grown up in Holland who lacked land upon which to achieve their ambitions.

Transport of about 20,000 Dutchmen to farms in Canada was arranged between the Netherlands and Canadian Governments and the bulk of these reached their destinations in 1948 and 1949. Suitable men were selected by the Netherlands Immigration Foundation (Stichting Landverhuizing) sponsored by the Netherlands Government. Civil and medical examinations on behalf of the Canadian Immigration Authorities then took place.

Netherlands pumping installations are expected to be sent to the area to be reclaimed and when the land has been made good it is to be used for supplying dairy produce and vegetables to nearby Vancouver.

The Dutch authorities have agreed in principle to the investment of the dollar equivalent of 700,000 Dutch florins in the project by a company established for the purpose and it is approved that the company shall provide remaining funds to the sum of $150,000. The new enterprise which is to bear the name of the Canadian Commercial Corporation of the Netherlands has already obtained the sole agency for a number of well-known Dutch exporting firms.

One of the directors of the Technical Bureau of the Federation of Water Boards has thoroughly examined the prospects of draining the area and has reported in every way favourably. According to his plan it will be possible to take $5\frac{3}{4}$ square miles into cultivation in as early as one year's time.

East African Agricultural Research

The East African Agriculture and Forestry Research Organisation

THE appearance of the Annual Report of the East African Agriculture and Forestry Research Organisation* for 1950 gives timely information regarding the progress of this important undertaking. On this occasion the report is accompanied by two other documents, viz.:—(1) A short history of the origin and objects of the existing organisation, and (2) a brief account of the history of the agricultural research carried out during the 20 years of its existence by its predecessor, the East African Agricultural Research Institute at Amani, which has now been absorbed into the newer and larger successor.

To one who, like the writer of the present review, can claim to have played some part in the preliminary discussions and negotiations which led to the inauguration of the organisation the three documents are of absorbing interest. It is, indeed, a source of satisfaction to note that, despite difficulties and while some of the features of the original scheme have undergone substantial modifications, the central idea of a research organisation which would take within its purview all forms of basic research on agriculture and forestry in East Africa, would be in a position to tackle new problems as and when they arose, would be closely and intimately linked to the work of the corresponding organisations for veterinary research, crop research and other specialised institutions and would provide a reference library and publication facilities for the whole East African region, is now within sight of achievement.

Progress in construction and staffing

By the end of 1950 the building programme at Mugega was nearing completion. For this a sum of £295,000 was made available from Colonial Development and Welfare Funds. The buildings comprise laboratories, workshops, an administration block and quarters for the staff. It is unfortunate that rises in the cost of living and materials have entailed some curtailment of the original programme, and it is equally unfortunate that similar causes have necessitated a reduction in the staffing target originally set at 45 research workers by 1957.

Nevertheless, to the reviewer it seems that the stage at present reached represents in itself no mean achievement. It is trite to say, 'by their works shall ye know them,' but it seems obvious that so soon as the organisation has demonstrated its ability to deliver the goods, and, be it said, the contents of the present report give clear indications of its potentialities in this regard, the ways and means for the completion of the programme must be forthcoming.

Progress in research

It is impossible in a brief review to do more than give some slight indication of some of the work accomplished. The detailed reports of the different divisions provide much information that is new and some of it we shall hope to record in subsequent issues of WORLD CROPS. The two directions in which particularly notable advances have been made are the fields of soil science and plant pathology. This is probably no coincidence, since the Director of the organisation, Dr. B. A. Keen, F.R.S., is a recognised world authority on matters pertaining to the soil, while Dr. H. H. Storey, F.R.S., the Deputy Director is equally well known as a plant pathologist and virologist. There can, in any case, be no question that these two fields present the most urgent agricultural problems confronting East Africa at present.

Research on soils

In regard to soils the outstanding points are fertility studies and soil classification. On the fertility side, although much still remains obscure, it is beginning to emerge that on the lighter soils of the East African region the main need is for nitrogenous manures, to which in seasons of adequate rainfall they show adequate responses. On heavier soils behaviour is more complicated and much more work is needed before valid generalisations emerge. In many cases phosphate applications are beneficial, but on the practical side of farm management the question of the best stage in the rotation at which to apply them arises. The accumulating evidence that a temporary grass ley should be a feature of East African rotations raises the point whether the grass break is not the best point for phosphatic dressings.

It is a matter for satisfaction that arrangements have now been completed for the continuation and extension of the East African soil survey, begun by the late Geoffrey Milne, by the appointment of Mr. Gethin Jones to take charge of this section in December 1950. This work is of fundamental and far-reaching importance as a basis for East African planned agricultural development, and one must hope that it will not be handicapped by insufficient provision of funds, resources and staff.

Plant pathology

The work on plant pathology has been mainly concerned with virus diseases of cassava and groundnuts, the mysterious Sudden Death disease of cloves in Zanzibar and forest pathology. In regard to cassava, this crop is of such widespread importance in the East African region that the destruction wrought by the two virus diseases which attack it is a serious matter. Thanks to earlier work by Dr. Storey (an account of which appears on another page), a number of resistant varieties have been developed. The work of producing new resistant varieties by hybridisation and their distribution to territorial agricultural departments has been extended.

In regard to groundnuts, virus diseases, mainly 'rosette disease', are a source of serious loss in East Africa. It has been shown that the disease is carried over from one season to the next by volunteer plants growing from missed seeds from the previous harvest. This may, however, be affected by seasonal conditions which influence the survival of the aphis vectors and their natural enemies. Work has, in consequence, been mainly concentrated on the aphis transmission process. It has also included studies on the efficacy of treatment with systemic insecticides to destroy the vectors, which shows promise if it should prove economic.

Sudden Death disease of cloves, which had, as a result of previous work, been attributed to a virus disease, has been the subject of further work by Dr. Nutman and his team in Zanzibar. It now transpires that the virus hypothesis cannot yet be regarded as proved. It has still strong circumstantial validity, but the work of Dr. Roberts, a member of the team, has revived interest in the possibility of a fungus pathogen being responsible.

Forest pathology is a subject the importance of which has become increasingly recognised of recent years and a considerable amount of work has been done by Dr. Rudd Jones on the canker disease of cypresses which constitutes a serious threat to plantations of this soft wood in East Africa. The work has shown

*Annual Report for 1950. East African High Commission. Nairobi. 1951.

that *Cupressus macrocarpa* is much more susceptible to the disease than *C. lusitanica*, and that there is a marked fall in the incidence of the disease, which is caused by a fungus, if *C. macrocarpa* plants are removed. It has also been shown that there are two strains of the fungus one of which is much more virulent than the other.

Other work

Space precludes more than passing mention being made of the numerous other lines of research and other work in progress. They include plant physiology, systematic botany, forestry and statistics. Also attached to the Organisation are several ancillary schemes including one for research on termites and another on the mollusca of North East Tanganyika.

A very interesting ancillary activity is the scheme for training suitably qualified men for land use work in the Colonies. It is in charge of Mr. C. G. Trapnell, whose work on ecological surveys in Northern Rhodesia is deservedly so well known. It takes the form of carrying out a series of field surveys in East Africa having regard to areas of potential economic importance. It should, therefore, apart from its training aspect, be of value to East Africa in the production of ecological maps and information of value on land resources.

Conclusion

Taken as a whole the report is a record of solid achievement and an earnest of greater things to come in the future. Provided a steady course of development can be pursued and a reasonable freedom from the effects of political upheavals and ill-conceived popular aspirations secured, there seems every prospect of the organisation proving of inestimable value to East Africa, thereby justifying the beliefs of those who were responsible for its conception. H.T.

The Inter-American Institute of Agricultural Sciences

TODAY the outstanding requirement of tropical agriculture is the application of modern scientific discoveries and methods to enable the yields from tropical crops to be raised from the very low levels which are the rule in many tropical countries, and to protect them from the numerous pests and diseases which threaten their production.

In many lands research institutes and research organisations have been established and research branches of Departments of Agriculture created with this end in view. Some of these have already been described in previous issues of WORLD CROPS. Notable examples in the British Commonwealth are the Imperial College of Tropical Agriculture in Trinidad and the East African Agriculture and Forestry Research Organisation in Kenya, the annual report of which is reviewed on another page of this issue.

A parallel development in the Western Hemisphere is the Inter-American Institute of Agricultural Sciences which was created some years ago at Turrialba in Costa Rica. This is specially remarkable because it is an international organisation intended to serve the interests of countries in the South and Central American region. For the following account of it and for the illustrations which accompany it we are indebted to the authorities of the Institute.

Foundation and objectives of the Institute

The Institute was founded in 1942 in fulfilment of a resolution approved by the Eighth American Scientific Congress held in Washington in 1940. Subsequently a convention was entered into by which a number of American countries agreed to recognise the Institute as a permanent organisation and this became effective on December 1, 1944.

Harvesting 'Adlay' (*Coix lacrymajobi*), **a promising grain selection introduced to Costa Rica from the Philippines**

The objective of the Institute, according to the terms of that convention, is to stimulate and promote the development of the agricultural sciences in the American Republics through research, teaching and extension in the theory and practice of agriculture and related fields.

To date the following countries have signed and ratified the convention: Costa Rica, Nicaragua, Panama, United States, Honduras, Dominican Republic, El Salvador, Guatemala, Venezuela and Mexico. The following have signed the convention but have not ratified it yet: Cuba, Ecuador, Uruguay, Chile, Bolivia and Colombia. No action has yet been taken by Argentina, Brazil, Haiti, Paraguay and Peru.

Administration

The Institute is one of the specialised agencies of the Organisation of American States (OAS), the council of which is its supreme directive board; to help to manage the affairs of the Institute there is an Administrative Committee elected by the Board which advises the Director of the Institute. The Director is appointed by the Board; the present director is Dr. Ralph H. Allee.

The composition of the Administrative Committee is as follows: Prof. H. Harold Hume, University of Florida (Chairman); Senor Carlos Madrid, National University of Colombia; Senor Marianne Montealegre, formerly Minister of Agriculture of Costa Rica; Mr. Knowles A. Ryerson, University of California.

Organisation

The headquarters of the Institute are located at Turrialba, where are the buildings, laboratories and experimental plots. Its work falls under two headings, training and research. For administrative purposes it is divided into six departmental units, viz.: Economics and Rural Life, Plant Industry, Animal Industry, Agricultural Engineering, Extension Services and Scientific Communications, while a service of renewable resources has recently been added. As part of the Institute the Orton

Commemorative Library is maintained, which contains approximately 10,000 bound volumes and receives regularly about 350 journals; it is also the headquarters of the Inter-American Cocoa Centre, which acts as Secretary to the Inter-American Technical Cacao Committee and carries out training and information programmes in relation to that crop.

The technical staff of the Institute numbers 38 technicians, coming from Bolivia, Colombia, Chile, Costa Rica, Haiti, Mexico, Peru, Puerto Rico and the U.S.A.

The Institute trains students from the member countries and conducts research not only at Turrialba, but also co-operatively with the experiment stations in the various countries of America, as well as providing consultative services and technical assistance to all member countries.

Provision of funds

Of the budget for 1949-50 of $440,429 43% is represented by quotas from the member countries at the rate of one dollar per thousand inhabitants; the rest is represented by farm income, grants and other income. The most important special donations received in the fiscal years 1949-50 were those made by the American Cocoa Research Institute, American International Association for Economic and Social Development, King Ranch and the Rockefeller Foundation. The organisation of American States gave in 1949-50 $27,500 to intensify the research on coffee.

Training courses

The training activities of the Institute commenced in January, 1947. At the present time 51 students from Brazil, Colombia, Costa Rica, Ecuador, United States, Haiti, Mexico, Nicaragua, Peru and Venezuela are registered. Among these students are also two Filipinos and one Canadian.

In addition the Inter-American Cacao Centre trains annually 15 students from the cacao producing countries of the Americas. The Extension Department of the Institute gives training to 20 students annually in the application of rural science to practical conditions. In this connection a rural training centre at Nocho Buena is in the initial stage of development. The course of instruction for the main student body includes the study of various aspects of the agriculture of tropical crops, notably coffee, rubber and abaca as well as animal industry, forestry, agricultural economics and sociology.

Research activities

The main research activities at present in progress were initiated in 1946. In the following paragraphs the general scope of the various lines of work in progress are indicated.

Agricultural economics

1. Analysis of the price structure of agricultural commodities.

2. Economic studies on coffee plantations.

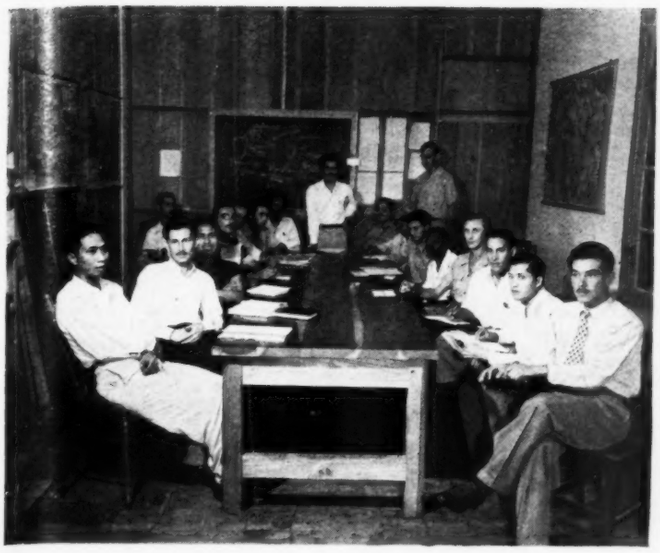
3. Studies of the development of a rural community in regard to social organisation, health and sanitary conditions, etc.

Plant industry

4. Crop research in regard to the production of improved crop plants, the study of their physiological processes and methods of controlling pests and diseases. Most of the work under way is with the following crops: Coffee, cocoa, corn (maize), vegetables and potatoes.

5. The production and improvement of crop plant varieties of possible economic value, especially pasture crops, oil plants, textiles and new food plants.

(*Top*) **View of the Central Building, Inter-American Institute of Agricultural Sciences, Turrialba, Costa Rica.** (*Bottom*) **Costa Rican technician inspecting experimental plot of Belleza sorghum**



(Left) **These students at Turrialba hail from Brazil, Colombia, Ecuador, Haiti, Mexico, Nicaragua, the Philippine Islands and the U.S.A.** *(Right)* **Physiological studies on coffee seedlings. Costa Rican technician with seedlings being grown in different nutrient solutions to determine effects of various elements on relative development of the plants**

Animal industry

6. The progressive improvement of beef cattle based on native stocks and the Santa Gertrudis and Brahman breeds.

7. Cross breeding of native cattle with Brown Swiss, Jersey, Holstein and Sindhi, and the selection of Nicaraguan native cattle for the production of dairy cattle adapted to tropical conditions.

8. Feeding tests with pigs based on local products, such as bananas and sugar cane, and the improvement of native stock.

9. Studies on the feeding and handling of poultry under humid tropical conditions and the improvement of the native stocks.

10. The improvement of native horses based on the Quarter Horse breed.

11. The utilisation of improved pasture lots in cattle feeding.

12. Study of the physiological reactions of cattle and pigs to climatic variations.

13. Operation of a creamery plant and a slaughter house suited to small or medium sized communities.

Agricultural engineering

15. The determination of the extent and effect of soil erosion.

16. The utilisation of drainage in the subsoil.

17. The drying and storage of food grains, especially rice and corn.

18. The drying of coffee.

Publications, etc.

The Institute publishes a quarterly journal of agricultural science which conveys the results of recent research and investigation. It also arranges for the publication of the results of scientific research at Turriabla through other appropriate channels in member countries.

It has also organised a service of bibliographic references for the use of technicians and agricultural research workers in the Americas, including the circulation of documents and the provision of photostat copies of them for the convenience of workers.

The Institute arranges for the interchange of scientific personnel with other institutions and holds frequent technical conferences, meetings and symposia for the interchange of ideas and experience.

Photos: Inter-American Institute of Agricultural Sciences, Turrialba, Costa Rica.

Rotary Cultivation Trials for Forestry Work

Early this year a series of trials were carried out by the Forestry Commission to investigate the possibilities of rotary cultivation for clearing land designed for afforestation. The Commission's report is the first such report which has come our way dealing with this new recognised system of rotary cultivation.

The machine under test was the Howard Rotovator Heavy Duty Attachment, a large edition of the original Rotovator tractor attachment made by Messrs. Rotary Hoes Ltd., developed in the first instance for the cultivation of sugar plantations in the Colonies. Briefly, this machine consists of a rotor, controlled by the tractor transmission clutch. Rotation is in the direction of travel and the hoe blades make many cuts to each forward foot of travel. Originally, only one type of blade was available, but from experience gained in France a shorter but heavier blade was designed for forest work. Clutches are provided at each end of the rotor to act as a safety device should the blades meet an obstruction. They are automatic in action and control of the rotor is by the tractor transmission clutch.

Two sets of trials were held, the first to find out whether a rotor attached to a TD.18 crawler tractor could, at an economical cost, provide cultivation suitable for the purpose of afforestation, and the second to amplify this information.

Trials were carried out on a variety of soils and undergrowth conditions ranged from hard pans with 15in. deep peat to an area of dense hazel coppice averaging 15 ft. in height intermixed with ash, birch and field maples.

Results from the first trials showed that the equipment was effective in clearing and cultivating most types of scrub areas, converting heathland to nursery requirements, cultivating areas where suppression of weeds such as bracken is desirable, cultivation of rides as fire breaks and as a mixer for road construction purposes where cement stabilisation is required.

Conclusions from the second trials show that the machine may not be the answer to the clearance of heavy coppice averaging 15 ft. in height. But the report sums up that it is considered that the machine is robust and quite adequate to stand up to the hardest work for a suitable period provided maintenance is properly carried out and the clutch tension adjusted correctly.

The Rejuvenation of Ceylon's Coconut Plantations

Like everything else, plantations of permanent tree crops grow old, and a time inevitably arrives when owing to old age the retention of the trees is no longer an economic proposition. Often this is not realised, especially by small cultivators, who tend to retain trees so long as they continue to produce any crop at all, notwithstanding that their excision and replacement may be long overdue. We have previously published various articles on the Ceylon coconut industry, and in what follows the efforts now in progress under the auspices of the Ceylon Government to help to bring about the rejuvenation of ageing coconut plantations are described and discussed. It is based upon information supplied by the Director of the Ceylon Coconut Research Scheme.

A FEW years ago the Government of Ceylon appointed a commission to enquire into the circumstances of the coconut industry. Coconut production is the second most important agricultural industry in that Dominion, the leading place being taken by tea. It is estimated that the total area under coconuts is roughly 1,100,000 acres, while in 1948 the total value of exports of coconut products was estimated to be Rs. 153 million. As only about half the crop is exported, the remainder being consumed locally, the great value of the industry to the island can be appreciated.

Perhaps the most important recommendation of the Commission in its report which was published in 1949, was that 420,000 acres of coconuts were over 60 years old and needed to be replanted. The proposal then made was that the work should be carried out, on a ten-year plan, at a rate of 42,000 acres a year—a stupendous and probably impossible undertaking.

Actually the work of replacing old, neglected and low-yielding palms and the opening-up of new areas to replace those which have been found unsuitable for coconuts will have to be a continuous and never-ending task, because as fast as young seedlings are planted older palms are continuously becoming less productive and over-age.

It is better, therefore, that the work should progress continuously at a rate which will ensure that the work is done properly and not rushed or scamped, and that only the best planting material is issued to the public.

Rehabilitation will have to be regarded therefore as a permanent feature of the industry, and the funds provided will be in the nature of a recurrent depreciation charge which, after all, is only normal business practice.

Rate of depreciation

The correct rate of depreciation for a coconut plantation on the basis of an 'economic life' of 70 years is obtained by dividing the total acreage under coconuts by 70 and this gives a replacement rate of 15,000 acres per annum. Of this, it can be assumed that a large part will continue to be replanted by private enterprise as many owners prefer to use their own planting material. The balance is being replanted with selected seedlings produced in the nurseries laid down by the newly-created Planting Division of the Coconut Research Institute.

This work is being financed by an annual allocation from the vote of the Department of Agriculture, and the funds so allotted are being steadily increased each year as the organisation develops. The wisdom of this method is obvious when it is considered that the work has to be properly planned and staff has to be carefully selected, trained and expanded as required.

It would be fatally easy to recruit unsuitable men and to waste large sums of public money by hurriedly laying down nurseries in the wrong places and of the wrong size and by producing large quantities of seedlings in excess of local demand. As it is, demand in all areas has been equal to or greater than the supply, but as the work develops it will, of course, be necessary to do more to create public interest and enthusiasm, particularly when

(*Top*) **Coconut nursery at Hettipola showing the method of laying down the seed nuts. The nuts have been laid down three months and are just beginning to show signs of germination.** (*Bottom*) **Coconut seedlings seven months after planting**

(*Top*) **A coconut nursery under mature palms on Palugascocwa Estate. Seedlings about nine months old.** (*Middle*) **An example of a well-run coconut nursery near Galle, Southern Province. Seedlings about eight months old.** (*Bottom*) **Demonstration plot showing equilateral triangular planting, 25ft. x 25ft.**

the price of copra begins to recede, when, of course, less money will be available for replanting.

Effects of rising prices

The work has been continuously hampered and curtailed by the soaring price of coconuts, which has made it difficult to obtain sufficient selected block nuts of the approved quality at reasonable prices. Growers have been most reluctant to sell even at the high price of Rs. 15 per thousand nuts.

In consequence the present cost of producing a selected block nut seedling is about Rs. 1, depending on the locality, due partly to the high price of seed nuts and partly to the high standard of selection, which ensures that only the very best planting material is supplied to the public. It is a fact which is not sufficiently appreciated that on most properties three-quarters of the crop is obtained from a quarter of the palms because in the early days of the industry there was no proper selection, and on some estates nuts rejected for copra making were even used as seed nuts. It would be fatally easy to follow this bad example today and lower the standard in order to produce large quantities of cheap seedlings and so rapidly plant up a very much larger acreage with inferior stock.

At the present time, when private nurserymen are advertising seedlings at 75 cents each and over, these carefully selected block nut seedlings are being sold to the public at the subsidised price of 50 cents each which, with the present price of coconuts and copra, should be within the reach of all growers except those whose properties have been adversely affected by the recent long succession of droughts.

It is obvious that the demand for seedlings is due to the present period of prosperity, and it is quite apparent that additional demand could be created by publicity and propaganda if and when increased funds are available. Up to now the money allotted for replanting has been fully spent; if the prices of coconut products were to decline, demand for seedlings may have to be artificially fostered by reducing

the price of seedlings and by active propaganda in the vernaculars in order to maintain the correct rate of replacement of this key industry in the economy of Ceylon.

Procedure adopted

Starting from scratch, the work has been gradually developed and extended on sound lines, and in 24 months since the inception of the scheme in March, 1949, no less than 22 nurseries have been established. In this same period 1,077,835 seed nuts have been laid down; the equivalent replanted acreage is approximately 11,000 acres, *i.e.* 1% of the total acreage to be replaced.

These nurseries are well distributed over the coconut areas of Ceylon.

The gradual development of the work is indicated by the following figures:

	Total Vote Rs.	*Nurseries*	*Staff*
March - Oct., 1949 ..	137,468	6	18
Oct., 1949 - Oct., 1950	179,300	15	21
Oct., 1950 - Oct., 1951	410,000	22*	24

Eight additional nurseries* will be laid down during the current financial year if and when the increased vote recommended for the 1951/52 season is approved. This is because there is a time lag of eight months between the laying down of a selected block nut in the nursery and its selection prior to sale, and it is this fact which holds up progress because it makes it impossible to prepare new nurseries until the succeeding estimates are finally confirmed.

* 100 block nuts yield 60 selected seedlings—1 acre.

Government Coconut Nurseries in India

It is of interest to note in the foregoing connection that the Report of the Indian Central Coconut Committee for 1949-50 indicates that under its aegis a large number of Government Coconut Nurseries have been established in various coconut growing provinces of India with the object of extending and improving the production of coconuts.

Schemes have recently been sanctioned for the establishment of additional nurseries in Bombay, Mysore, Orissa and Travancore. The annual targets for each of these aim at the production of from 15,000 to 20,000 seedlings per annum.

Imperata Grass

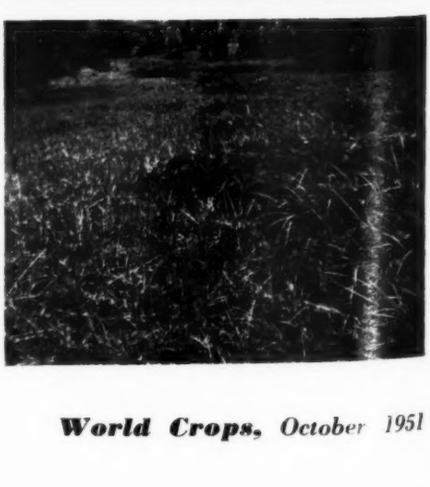
IN our issue for April 1951 there appeared an article under the above title in which was discussed the problem of the control of the grass *Imperata*, which is a serious menace in many parts of the wet tropics.

In a recent letter to the editor of WORLD CROPS, Dr. G. Watts Padwick of Imperial Chemical Industries referred to the article in question and pointed out that in Zanzibar the grass had been successfully controlled by the Department of Agriculture in clove plantations by the employment of the creeping vine Kudzu (*Pueraria sp.*)* as a smother crop. He enclosed four photographs illustrating this which we reproduce on the right in the belief that they will be of interest to our readers.

In his letter, Dr. Watts Padwick stated that 'the photographs were taken at the Kizimbani Experimental Station, Zanzibar, on February 6, 1949, when I visited the station in company with Mr. Tidbury of the Department of Agriculture. This area was devastated by "sudden death" disease of cloves some years ago and was replanted in 1935 with young clove trees. Although the trees thrived under the care they received, lalang established itself between the rows and the Department of Agriculture could not keep the grass down economically. The density of the grass can be seen from photograph 1 (*top*). The Department decided to try planting kudzu vine with the object of smothering the *Imperata*. Photographs 2 and 3 (*middle two*) illustrate how completely the vine smothered the lalang. Perhaps the most striking illustration is that in photograph 4, (*bottom*) which pictures the kudzu vine advancing like an irresistible flood over the grass. Mr. Tidbury told me that the kudzu vine eventually killed out the lalang, but I did not myself dig around to see whether the roots of the grass were still alive.'

It may perhaps be added that in the original article reference was made to the employment of *Centrosema pubescens* in a similar connection in keeping down *Imperata* on road verges in Malaya.

Dr. Watts Padwick's photographs show clearly how effective *Pueraria* has been in keeping down this grass under Zanzibar conditions, and it would seem that this method may be worthy of careful attention by planters and agricultural authorities in countries in the wet tropics where *Imperata* is a serious problem.



*According to Paul in *Tropical Agriculturist*, CVII, pp. 15-20, 1951, the so-called 'Kudzu' of the east and tropical countries is *Pueraria phaseoloides* (Roxb.) Benth. and not *P. thunbergiana* (Sieb. and Zucc.) Benth., which is the species extensively grown in U.S.A. for pasture and hay. The species grown in Zanzibar may be *P. phaseoloides*.

Better British Farming

Dr. Slade's Prize-Winning Essay

To mark the Festival of Britain the Royal Society of Arts offered a Gold Medal and a prize of £500 for the best account of 'a means of promoting the production or the utilisation of food in Britain.' As recently announced, the competition was won by Dr. R. E. Slade, for many years Director of Agricultural Research to Imperial Chemical Industries, Ltd., for an essay in which he described the system of farming carried out on his farm in Hertfordshire by which he has succeeded in very materially increasing the return of food per acre, as compared with neighbouring similarly situated properties. Dr. Slade's essay has been published in the Journal of the Royal Society of Arts, and from it the following condensed version has been prepared.

THE farm in question comprises 65 acres of permanent grassland and 150 acres of arable land. The two sections are operated separately.

The grassland is used for intensive grazing of a dairy herd and for growing grass to dry for winter feed. Large quantities of nitrogen, phosphate and potash fertilisers are used on these fields. The arable land is worked on an eight-year rotation including a four-year ley of pure lucerne. This system yields heavy crops of corn and roots and uses only small quantities of nitrogenous fertilisers.

Dr. Slade states that the two systems produce annually some 3,000 lb. of starch equivalent and 800 lb. of crude protein per acre. For comparison the ordinary four-course rotation of wheat, roots, barley and clover produces about 1,900 lb. of starch equivalent and 330 lb. of protein equivalent per acre.

They are not claimed to be new, but merely the logical development of proven methods of good husbandry based on knowledge of fertilisers, insecticides, selective weedkillers, grass drying and lucerne leys in the arable rotation.

The grassland area

The majority of the grassland is used for intensive grazing and for cutting for drying. It receives annually 4 cwt. of superphosphate and 2 cwt. of muriate of potash per acre early in March. Three further applications of nitro-chalk are made, usually in March, June and August.

Grazing starts about April 1, and the fields are grazed in strips and controlled by means of a movable electric fence; if cows are in a field for more than four days a back fence is used to keep them off the portion grazed four days earlier. One acre of pasture generally provides grazing for about 50 cow-days.

Land that has been grazed is mown to remove any patches of grass left by the cattle and harrowed to spread the dung. It is then left for a month before being grazed again.

If the grass is to be cut for drying the treatment is the same as for grazing, but the first cut is made at the end of April or the first week in May; this will yield 10 to 20 cwt. of dried grass, containing about 19% crude protein per acre. After the first cut the grass is allowed just to come into flower and is then cut for drying. This is during June, and the dried grass will contain only 11 to 13% crude protein; it is baled and used as a maintenance ration for cows and young stock. The yield of this second cut is about 30 cwt. per acre.

Many of the grasses, particularly cocksfoot and smooth-stalked meadow grass, do not flower again after having been cut when first in flower, and the next two cuts produce grass which when dried has a high protein content (19 to 22%). The 40 acres of intensive grazing land in 1950 provided 65 tons of dried grass and hay and 200 days' grazing for 25 cows. If the cows consume 25 lb. per day of dry matter in the grass it is estimated that each acre supplies 3,500 lb. of starch equivalent and 1,050 lb. of crude protein.

The system can only be carried out with the help of a grass drier. This enables more effective grazing management and some of the dried grass is sold to buy brewers' grains and barley for the cattle. Dr. Slade uses an I.C.I. drier and one designed by himself and manufactured by the Edward Curran Engineering Ltd., under the name of the Slade-Curran drier.

To control weeds M.C.P.A. is applied to the grazing land; this has proved completely successful, eradicating horsetail and creeping buttercups. Intensive grazing would have been impossible if these weeds had been present.

The arable area

The 153 acres of arable land are divided up into eight fields, or groups of fields, for the eight-year rotation which is as follows:

1. Lucerne sown in June on clean land and cut for drying in August.
2. Lucerne cut for drying three times.
3. Lucerne cut for drying three times.
4. Lucerne cut for drying four times.
5. Wheat.
6. Cleaning crop. Potatoes or market garden crop, or rye to be cut for drying. Farmyard manure is applied.
7. Wheat.
8. Barley.

During the first year the land is autumn-ploughed and given 2 tons of chalk per acre. During the spring it is harrowed to get rid of germinating weeds and in mid-June it is rolled and lucerne sown at the rate of 20 lb. of inoculated seed per acre. With the seed is sown 2 cwt. of ammonium phosphate and 3 lb. per acre of flea beetle powder containing 5% gammexane to prevent wireworm attack on the lucerne. The yield in the first year is generally about half a ton per acre of dried lucerne of over 20% crude protein content.

The first cut of the second year is made about the third week in May when weeds are not very high. After this no weeds show before the fourth year. Two further cuts are made during the second year, the yield of dried material averaging 3 to 3½ tons per acre. In the third and fourth years three cuts are also made. The yields are of the same order.

Yeoman wheat is sown in the autumn of the fourth year after ploughing up the lucerne, together with a dressing of 1 cwt. of sulphate of ammonia per acre, or a similar dressing of a complete fertiliser such as I.C.I. No. 1. The yield of wheat in the summer of the fifth year averages around 35 cwt. per acre.

After a cleaning crop in the sixth year another crop of wheat is grown in the seventh year, again yielding 35 cwt. per acre, and in the last (eighth) year of the rotation Plumage Archer barley is grown; this yields about 30 cwt. per acre. The crop is sprayed with M.C.P.A. to destroy charlock, when necessary.

Under this rotation an average yield per acre of 3,070 lb. of starch equivalent and 790 lb. of crude protein is obtained.

Importance of nitrogen

The outstanding feature of the farming system as a whole is the heavy dressing of nitrogenous fertilisers given to the grassland and the comparatively light dressing on the arable land. Dr. Slade states that he could manage without any nitrogenous fertilisers at all on his arable land, since the lucerne fixes all the nitrogen needed.

He maintains that the production of large yields of high protein dried grass is due not so much to cutting the grass when it is young, but to the use of heavy dressings of nitrogenous fertilisers. In general, 60% of the nitrogen applied as fertiliser is recovered as crude protein in the grass. It may be possible, however, he concedes, to grow large quantities of high protein grass without the use of nitrogenous fertilisers after a four-year lucerne ley.

In Britain clovers grow for a shorter period than do most grasses, and on this account it is not possible to obtain heavy crops of high protein fodder by growing grasses mixed with a legume, especially as it is difficult to obtain a satisfactory balance between the two plants. For this reason, on the grassland section, grass and grass only is grown. Further, Dr. Slade considers that it is cheaper to grow lucerne than grass if the aim is to produce a high protein food. If grown on chalk, the lucerne would require additional fertilisers.

The cost of growing grass is about £14 2s. 5d. per acre per annum, and as the yield is about 3 tons of dried grass per acre the cost per ton of dry matter per acre standing in the field is about £5.

Application

This system of grassland farming should be applicable wherever it is possible to spread lime and the rainfall is sufficient or there is a high water table. Even where the rainfall is only 23 in. per annum it can be worked in the summer and in the autumn. If the nitrogenous fertilisers have not been utilised, owing to a drought, they will make the grass grow during the autumn and winter. Grass, which is growing in the winter because there is available nitrogen in the soil, is not damaged by a few days' frost.

The growing of lucerne on half the arable land will modify the economic system of the farm. Dr. Slade introduced a grass drier capable of drying all the lucerne. But other methods of using lucerne are known. Cattle can be grazed on it in the summer and fed on lucerne silage in the winter. Beef cattle should need no other food except oat or barley straw. No corn or concentrates would be required. If beef calves were bought at six months old and sold at two and a half years, one acre of lucerne would support an animal for a year. One hundred acres of arable land, including 50 acres of lucerne would take 25 calves each year and produce for sale 25 fat cattle as well as 50 acres of arable crops.

The flexibility of the system is obvious; the table in the next column, reproduced from Dr. Slade's paper, shows the average yields of crude protein and starch equivalent from various field crops in comparison with those obtained under the two systems described.

	Yields in lb. per acre	
	Crude protein	*Starch equivalent*
The grassland system ..	1,050	3,500
The lucerne ley arable system	790	3,070
Sugar beet 8.6 tons ..	212	2,900
Potatoes 6.7 tons ..	315	2,780
Kale 20 tons ..	980	4,100
Wheat 18 cwt. ..	250	1,500
Barley 16.4 cwt. ..	190	1,300
Oats 16 cwt. ..	190	1,100
Beans 16.3 cwt. ..	380	1,200
Ordinary grazing ..	190	800

(The text of Dr. Slade's paper can be obtained on application to the Secretary, The Royal Society of Arts, John Adam Street, Adelphi, London, W.C.2.)

Insect Pests of Sugar Cane

AT the seventh international congress of sugar technologists held at Brisbane in September 1950 a large amount of information was forthcoming about the status of insect pests of sugar cane in various countries, and from the reports on this gathering the following has been abstracted.

Moth borers

The sugar cane moth borer (*Diatroea sacharalis*) is a serious pest in many countries. Ingram and others regard it as the most destructive agency in Louisiana and Florida[1,2,3]. In these countries dusting with powdered Cryolite or with powdered Ryalia has been found effective as a control. The insecticides are applied mainly by aeroplane at the rate of 5 kg. per acre. More than 60,000 acres in Louisiana were treated in this way in 1950.

The eggs of the insect are parasitised by *Trichogramma minutum*, and during the past three years massive liberations of this parasite have been made in Louisiana but without showing positive results.

On the other hand this parasite has been bred and liberated on an extensive scale in Barbados, where Tucker[4] reports very satisfactory results.

In Louisiana it has been found that applications of 2-4 D for weed control as well as of sulphur, DDT, parathion and chlordane to the soil for the control of soil inhabiting insects has unfavourably influenced the incidence of *Trichogramma*. A number of other parasites of the borers have been discovered in various countries, and 13 of these have been introduced into Florida and Louisiana, but only two have established themselves, while the results are doubtful.

White grubs

Various species of white grubs in the soil—larvae of melolonthid beetles—cause losses in many countries by attacking the roots of sugar cane.

Good results against this type of insect have been reported from the use of BHC in Queensland by Mungomery[5] and from a mixture of Aldrin and BHC by Wolcott[7] in Puerto Rico.

In Louisiana, Bynum[6] reports that control of such insects has been obtained by the use of chlordane, toxaphene and parathion. BHC has here been found adversely to affect the germination of cane plants. Good results have also been reported from Queensland by Mungomery from the use of BHC against the wireworm *Lacon variabilis*.

H.T.

REFERENCES

1. J. W. Ingram *et al.*: 'Insect Pests of Sugarcane in the United States.'
2. Do. do.: 'Insecticidal Control of the Sugar Cane Borer in Louisiana.'
3. Do. do.: 'Biological Control of the Sugar Cane Borer in the United States.'
4. R. W. E. Tucker: 'A Twenty Year Record of the Biological Control of One Sugar Cane Pest.'
5. R. W. Mungomery: 'The Status of Benzene Hexachloride in the Control of some Queensland Sugar Cane Pests.'
6. E. K. Bynum *et al.*: 'Control of Soil Insects in Louisiana Sugar Cane Fields.'
7. G. N. Wolcott: 'The Chemical Control of White Grubs in Puerto Rico.'

Oil Fractions as Selective and Total Weedkillers

G. E. BARNSLEY

Shell Experimental Station

In previous issues of WORLD CROPS *there have appeared articles dealing with petroleum as an insecticide and the various uses to which petroleum products can be put on the farm.* Below we reproduce a talk, delivered recently to the Association of British Insecticide Manufacturers, in which the employment of petroleum oil fractions as weed killers is discussed.*

THE phytotoxicity of an oil depends firstly on its penetration into the plant leaf and secondly on its inherent phytotoxic properties. Aspects of these two important factors will be discussed in the first part of this paper.

Penetration of oil into the plant leaf depends on such factors as (a) plant (in particular leaf) morphology, and (b) the physical properties of the oil used.

(a) Morphological factors

Morphologically the leaf stomata are the most important feature, for oils penetrate mainly through stomatal apertures. The extent of the oil penetration is dependent upon light intensity and atmospheric humidity, for these factors control the opening and shutting of the stomata. Tucker's work[4] on apricot leaves illustrated this. He applied an oil to the upper surface of the leaf (where there are few stomata) and to the under surface of the leaf (where there are many stomata). With the application to the upper leaf surface no oil damage was apparent for two months, but with application to the lower leaf surface oil damage was observed within four to seven days. By means of tying paper bags over apricot leaves he was able to measure the extent of oil damage under different light intensities. He concluded that with a light intensity of five lumens, which is roughly equivalent to artificial light, no oil damage was observed. With a light intensity of 100 lumens, which is roughly equivalent to the light intensity in the deep shade of a tree with the sun shining, he observed damage similar to that caused in direct sunshine.

The morphological feature of leaf thickness is also known to affect oil penetration. For example, it has been reported that oil damage to apple buds depends on the position of the buds in the tree. It is thought that buds in deep shade develop leaves with fewer cell layers than those in direct sunlight, and that these thinner leaves are more easily penetrated by oils. A similar effect on thickness of leaves in buds is produced by potassium deficiency, which is also known to be correlated with oil damage. With regard to leaf shape we have often wondered whether there is any connection between the fact that many plants which are resistant to light oil fractions are characterised by deeply divided or spine-like leaves; for example the leaves of carrot, pine, Mayweed (*Matricaria inodora*), Horsetail (*Equisetum arvense*), Spurry (*Spergula arvensis*) and Fumitory (*Fumaria officinalis*). It has also been observed that oil resistant weeds are often resistant to damage by frost.

Special morphological features of the grasses may explain their particular susceptibility to oil damage; for example the ridges of the leaf blade may act as channels which hold oil and increase the exposed leaf area. But more important, we think, is the creep of oil between the rolled up leaf bases, a factor which leads to the rapid death of these stem-like structures.

* ' Petroleum on the Farm '. WORLD CROPS, **2**, 7, 310-312.
' Refined Petroleum Oil as an Insecticide '. *Ibid*, **3**, 1, 19-22.

(*Centre*) **Unsprayed weeds on a building site.** (*Left and right*) **Weeds sprayed with a total oil-based weedkiller**

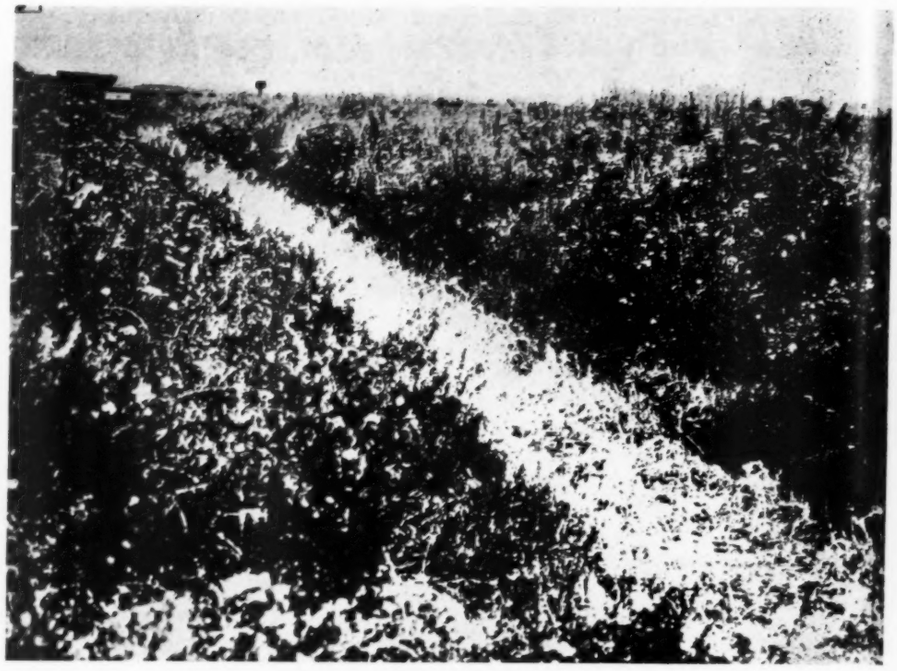
(b) Oil characters

The volatility of an oil determines the length of time it is in contact with the plant. Consistent with adequate penetration and oil deposit maximum volatility is required in a selective and pre-emergence weedkiller.

Young[1] investigated the distribution and effect of sprayed petroleum oils in potato, cucumber, turnip, barley and onion. He found within the range of viscosity of 30 to 400 secs., oils took from $\frac{1}{2}$ sec. to 5 mins. to penetrate into potato leaves. Oils in the higher boiling ranges remained on the leaf for the remainder of the growing season. He concluded that in these crops petroleum

oils passed from leaf to stem and root and were conducted mainly between cells.

The viscosity of an oil is not only correlated with its herbicidal effects but also with its toxicity to insect eggs. With plants, optimum viscosity is one that allows maximum spread and penetration of the oil and is not a fixed value. For example it differs for temperate and tropical areas. In the U.K., however, we have found the optimum viscosity for a selective weed killer in carrots to be fairly specific. Thus, adding 10% of a thicker carrier oil to a mineral spirit fraction appreciably reduced the kill of weeds obtained, probably, we think, because of increased viscosity and subsequent decreased oil penetration. Diesel fuel as a base oil for a total weed killer is much more efficient in temperate zones when thinned with a lighter oil fraction, for example a kerosine.



Striking example of weed control beside a railway embankment, effected by an oil-based weedkiller

Inherent phytotoxic properties of oils

In general we have found that the herbicidal effects of oils increase with increasing aromatic content and boiling range, but are limited by viscosity. Selectivity is also reduced by increasing the aromatic content and boiling range, and is, in fact, confined to relatively narrow limits in respect of these values.

However, oils originating from different world areas, or from different wells in the same country, may exhibit marked differences in phytotoxicity even when their physical specifications are identical. It is therefore evident that the ' make-up ' of the oil plays a considerable part in determining its suitability as a weedkiller base, and this in turn may be related to its place of origin and, in part, to the process treatment it undergoes.

Oils are a complex mixture of hydrocarbons, many of which have not yet been isolated as separate compounds and identified as to structural formula, although many main types are known. With the increasing knowledge of the chemistry of petroleum oils which is becoming available with each year it may be possible some time in the future to give exact quantitative and qualitative specifications for petroleum weedkillers. In the meantime, until the specific phytotoxic components of oils have been identified, aromatic content and boiling range are the most useful indications we have of the inherent phytotoxic properties.

Depending on their boiling range, oils exhibit two types of toxicity, namely acute and chronic forms. The former is caused by oils of relatively low boiling range and is selective, being characterised by the rapid burning of plant leaves. This type of toxicity usually reaches its maximum effect within 48 hours, by which time if the plant is not dead it may recover by new growth of axillary buds. Carrots are tolerant to oils with moderate acute toxicity. Chronic toxicity is caused by oils of higher boiling range, and is non-selective. Symptoms of damage usually take several days to develop, and these are characterised by a stunting of growth and yellowing of leaves. Carrots are injured by oils of even slight chronic toxicity.

Selective oils

We cannot at present give an entirely satisfactory biological explanation of the selective phytotoxic properties of oils, or even explain in physiological terms why oils are phytotoxic. There is evidence, however, of specific and direct interruption of photosynthesis. Minshall and Helson[2] showed that in parsnip (an oil resistant species) the interruption of photosynthesis was temporary, but in mustard (a susceptible species) it was permanent. Furthermore transpiration ceased permanently in mustard but was only temporarily reduced in parsnip.

The selective phytotoxicity of oil fractions is dependent on the ratio between the aromatic and non-aromatic parts of the oil and not on the amount of aromatics deposited per unit area. Thus if an oil of 15% aromatic content is a suitable selective weedkiller sprayed at 60 gal. per acre, it does not follow that an equivalent result will be obtained by spraying a similar oil of 30% aromatic content at 30 gal. per acre. In fact, such a procedure would in all probability cause considerable crop damage. From this it follows that there appears to be little scope for introducing the low volume-high concentration technique in spraying selective oil fractions.

Crops which tolerate selective oils include carrots, parsnips, parsley, pine, cranberry and various cultivated umbelliferous herbs.

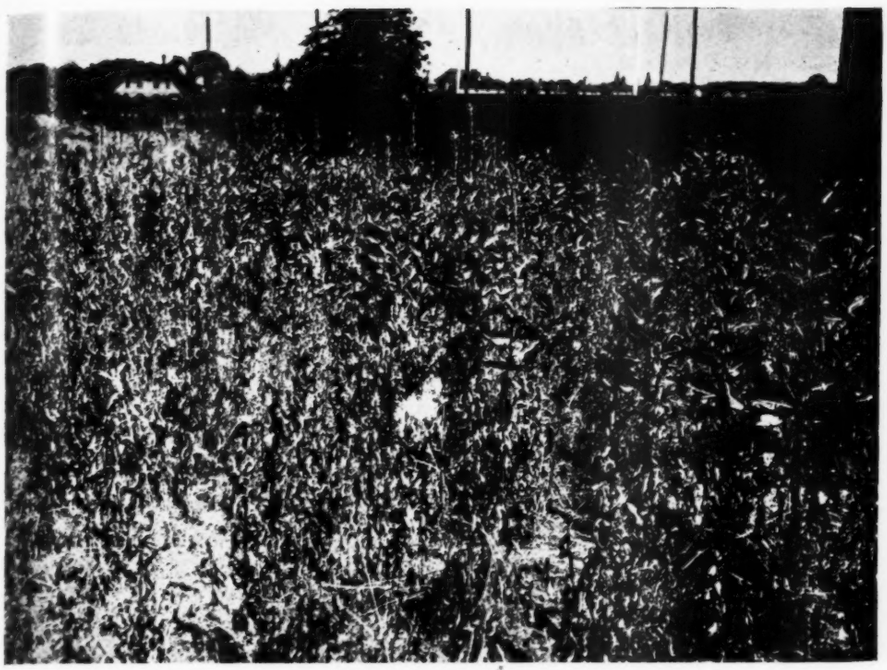
Optimum spraying time

It is often the case that farmers delay spraying their crops until weed growth is quite advanced, and that the weed population and potential infestation of a seed bed is frequently underestimated, particularly if examined during weed germination.

In the case of carrots our trials showed that the best weed control was obtained when the weeds were sprayed in the cotyledon stage. The carrots were also at this stage but no reduction in yield nor any damage to the crop resulted. The fact that certain weed seeds lying at or near the soil surface can be killed by mineral spirits[3] may also partly explain the effectiveness of early spray application.

Generally the best weed kill is obtained on bright, warm, sunny days, but we have obtained excellent results spraying in dull, humid conditions, during rain and with rain following spraying.

As crops are rendered more susceptible to oil damage at temperatures near freezing point, it is important to avoid



Control of overgrown weeds on a building site. (*Right*) **Sprayed with a total fortified oil weedkiller.** (*Left*) **Unsprayed control**

spraying selective oil fractions when there is a possibility of frost.

We have found a rate of application of 60 to 80 gal. per acre to be satisfactory under most conditions, and 40 gal. per acre to be approximately the lower limit of effectiveness. Lower rates of application, however, may be feasible when crop rows only are sprayed. We have obtained best results with sprays applied at a pressure of 50 to 75 lb./sq. in., and there were indications that higher pressures were unnecessary and possibly disadvantageous. Using a selected white spirit fraction of definite origin we found that one application gave better control than two applications of the same total quantity three days apart at 40, 60 and 80 gal. per acre.

Oil types

Two types of mineral oils are commonly used for selective weedkilling, mainly power kerosine and white spirits. Any petroleum product with a boiling range between approximately 140° to 300°C. can be classed as a kerosine distillate. The term white spirit is applied to a category occurring in the boiling range of approximately 150° to 250°C., and whose flash point exceeds 73°F. Their aromatic content varies widely. These white spirit fractions are obtained by the distillation of selected gasoline fractions and are characterised by the absence of strong odour, low sulphur content and absence of other non-volatile residues. The most suitable selective weedkillers produced to date are undoubtedly special white spirit fractions, for not only can they be standardised in respect of phytotoxic effects but also can be used with much less risk of tainting the sprayed crop. Furthermore, they can be recommended for use in bunching carrots and can be sprayed with safety on carrots at the cotyledon stage. While several growers have reported the use of TVO (tractor vapourising oil) with satisfactory results, the fact that there have been reported cases of taint, crop damage and variable weed kill both in the U.K. and abroad, indicates that uncontrolled variation in result does, in fact, occur.

When choosing an oil based selective weedkiller the farmer should weigh the premium he must pay for additional safety against the cash value of his crop. Thus while he might be prepared to use TVO on main crop carrots he may consider that the higher value of carrots for bunching justifies expenditure on a special grade of oil weedkiller.

The question of residual effects of oils in the soil has been raised. We can safely say at this stage that we have encountered no deleterious effects in the soil subsequent to the use of selective oil fractions in the U.K. and other parts of Europe or in the U.S.A. This is not surprising when it is realised how rapid is the evaporation of light oil fractions. With regard to the repeated application of heavier oils, which we are investigating in this country by long term experiments, there have yet been no indications in the U.S.A. of detrimental effects following the use of oils for weed control in citrus orchards, a technique which has been practiced during the past ten years.

Non-selective oils

Ideally a base oil for a total weedkiller should have a high aromatic content and should not be too viscous, otherwise leaf penetration will be inadequate. However, at present, oils are imported or refined in the U.K. in the main for fuel and lubricating purposes.

Occasionally oils imported for industrial purposes may be, by chance, suitable for use as herbicides. In this country an alternative method is to fortify commonly available oils of a lower order of toxicity with such chemicals as DNC and PCP. Oils, however, are not inexpensive commodities and have therefor been used as total weedkillers in the form of oil in water emulsions. While the effectiveness of such emulsions has been demonstrated in some tropical or sub-tropical areas against grasses and dicotyledenous weeds, it has been our experience working in temperate zones that oil emulsions caused only superficial damage to grasses, even when fortified, though the control of broad-leaved weeds was satisfactory. There is no contradiction of results here, for these merely reflect the fact that a hot sun is a better companion for a total weedkiller than the typical English summer. The use of oils as pre-emergence weedkillers has been investigated. It has been established that certain oils are safe pre-emergence weedkillers while others are not. It seems that the volatility of the oil is of paramount importance. With too low a volatility the oil will persist long enough in the soil to damage the crop.

Maximum weed kill is obtained by delaying the application of a pre-emergence spray until the latest possible moment, but, of course, the nearer to crop emergence the time of application, the greater is the risk of damage to the crop. Therefore in practice it is necessary to compromise between these two conflicting requirements, at the same time selecting the oil which can be applied nearest to crop emergence without causing damage. Thus in sugar beet certain oil fractions can be safely applied as late as two days before crop emergence. Pre-emergence spraying with oils in small seeded crops is a more hazardous procedure which needs further investigation.

REFERENCES

1. P. A. Young: *J. Agric. Research*, 1935, **51**, pp. 925-34.
2. W. H. Minshall and V. A. Helson: *Proc. N.E. States Weed Control Conf.*, 1949, pp. 8-13.
3. J. H. Stoeckler: *Scientific Monthly*, 1949, **68** (6), pp. 419-20.
4. R. P. Tucker: *Indus. and Engineering Chemistry*, 1935, 36.

Developments in the World Raw Cotton Situation during the 1950-51 Season

DUDLEY WINDEL

ALTHOUGH final returns of a number of crops have yet to be received, world production of commercial raw cotton during the present season will be around 26,960,000 bales, according to available statistical data. This compares with 30,210,000 bales produced in the 1949-50 season.

WORLD CARRYOVER AND PRODUCTION OF COMMERCIAL COTTON IN THE WORLD

AMERICAN IN RUNNING BALES ; FOREIGN IN EQUIVALENT 478 LB. NET BALES (000's OMITTED)

World Stocks, July 31, 1950	
U.S.A.	6,700
Canada	45
Mexico	240
Other North America	25
Brazil	645
Argentina	600
Peru	155
Other South America	125
U.K.	1,405
France	490
Italy	385
Russia	700
Germany (all zones)	325
Holland	100
Belgium	120
Sweden	60
Spain	35
Czechoslovakia	60
Poland	125
Other Continent	275
India	1,250
Pakistan	50
China	500
Japan	385
Turkey	105
Other Asia	110
Egypt	585
Belgian Congo	75
Other Africa	325
Australia, etc.	65
Afloat	600
	16,665
*World Production, 1950-51**	
U.S.A.	9,908
Mexico	1,150
Other North America	80
Brazil	1,600
Argentina	500
Peru	350
Other South America	130
Europe	205
Russia	3,300
Turkey	560
Persia	110
India	2,700
Pakistan	1,200
China	1,750
Burma	40
Other Asia	310
Egypt	1,740
Belgian Congo	205
British East Africa	320
Nigeria	60
French Africa	145
Portuguese Africa	135
Sudan	410
Other Africa	27
Elsewhere	25
	26,960

* Tentative estimate

United States production this season at 9,908,000 bales was about 6,000,000 bales less than last season, but this reduction was partially offset by an estimated aggregate increase of around 2,700,000 bales in other world crops. Larger harvests were gathered in Mexico, India, Pakistan, Turkey, Syria, the Anglo-Egyptian Sudan and certain minor cotton-producing countries, while the Russian and Chinese crops are also believed to have increased. Little change is indicated in the Southern Hemisphere crops grown in South America and elsewhere in Africa.

Adding the carryover to the indicated 1950-51 world production gives a total available supply of 43,625,000 bales, compared with 44,830,000 bales in the previous season. (*See table below.*)

Fuller details of the crops in the various cotton-producing countries are summarised below:

North America

United States. The revised estimate of the 1950-51 planted acreage is 17,828,000 acres, or approximately 9,500,000 acres less than the 1949 figure of 27,230,000 acres. The big reduction was due mainly to the Government's decision to establish maximum acreage quotas with a view to avoiding an excessive production. Unfortunately, the growing season over a large part of the belt was very unfavourable, and yields were sharply reduced by heavy weevil damage. The average yield per acre was returned as 269.2 lb., against 284 lb. in 1949-50. Total ginnings amounted to 9,907,918 bales, compared with 15,908,591 bales in the previous season.

Mexico. Although the 1950-51 planted acreage was about 20% to 25% larger than the 1949-50 area, the crop was adversely affected by an unsatisfactory growing season and insect depredations. The harvest, at around 1,150,000 bales, was consequently only very moderately larger than the output for the previous season.

South America

Brazil. A record amount of cotton seed for planting was distributed in south Brazil last autumn, and climatic conditions during the growing period were generally favourable. Estimates of the harvest still show some divergence, but average ideas are around 1,100,000 bales (478 lb. net), or about 300,000 bales more than the poor 1949-50 output.

The 1950-51 crop in the northern states turned out exceptionally good both in quantity and quality, due to almost ideal growing weather, and is estimated at slightly more than 500,000 bales (478 lb. net).

Peru. The 1950-51 planted acreage was appreciably larger and, with good climatic conditions in most of the Tanguis valleys, resulted in satisfactory yields. Estimates of the total harvest range from 350,000 to 375,000 bales (478 lb. net), compared with 335,000 bales realised last season.

Argentina. Acreage sown to cotton this season was around 20% greater than in 1949-50. Cool wet weather, however, delayed the maturity of the crop and yields were consequently disappointing. Production is provisionally placed at 100,000 to 110,000 metric tons, which would leave only a negligible exportable surplus.

SUPPLY AND DISTRIBUTION OF ALL COMMERCIAL COTTON IN THE WORLD*

AMERICAN IN RUNNING BALES ; OTHER GROWTHS IN EQUIVALENT 478 LB. NET BALES (000's OMITTED)

Season	*Carryover August 1*	*Production*	*Total Supply*	*Consumption*	*Destroyed*	*Carryover July 31*
1938-39	22,702	27,509	50,211	28,507	66	21,638
1939-40	21,638	27,326	48,964	28,496	206	20,262
1940-41	20,262	28,720	48,982	26,595	220	22,167
1941-42	22,167	25,616	47,783	25,033	165	22,585
1942-43	22,585	25,582	48,167	24,293	304	23,570
1943-44	23,570	24,521	48,091	22,566	121	25,404
1944-45	25,404	23,631	49,035	22,204	233	26,598
1945-46	26,598	19,890	46,488	23,110	337	23,041
1946-47	23,041	20,279	43,320	25,893	205	17,222
1947-48	17,546	23,489	41,035	26,975	230	13,830
1948-49	13,830	27,222	41,052	26,232	200	14,620
1949-50	14,620	30,210	44,830	27,915	250	16,665
1950-51	16,665	26,960	43,625	31,685	200	11,740

* Source : New York Cotton Exchange to 1946-47. Writer's estimates 1947-48, 1948-49, 1949-50 and 1950-51.

Africa

Egypt. Cotton plantings for the 1950-51 season were about 17% larger than a year previous, but excessively hot weather in the autumn marred the harvest prospect, particularly in Upper Egypt. Final ginning returns gave a crop of only around 1,740,000 bales (478 lb. net), or slightly less than the 1949-50 output.

Sudan. Area sown to cotton last autumn was increased by about 10%. The growing period was almost ideal, resulting in abundant yields and an all-time record production.

British East Africa. There were no important changes in the 1950-51 planted acreages in either Uganda, Kenya or Tanganyika. Aggregate production is estimated at 320,000 bales (478 lb. net), or about 20,000 bales less than that for 1949-50.

Nigeria. The exportable surplus from the 1950-51 crop is expected to reach 57,000 bales (478 lb. net).

Belgian Congo. Latest estimates of the 1950-51 harvest range from 205,000 to 215,000 bales (478 lb. net), against 234,000 bales in 1949-50.

Portuguese Colonial Africa. Owing to a more favourable growing season, the 1950-51 Angola/Mozambique crop at around 135,000 bales (478 lb. net) was about 30,000 bales larger than the poor 1949-50 output.

French Colonial Africa. The total 1950-51 commercial crop in the overseas colonial territories is estimated to have approximated the 1949-50 figure of 145,000 bales (478 lb. net).

Europe

Continent. Owing to a larger Greek production, the aggregate 1950-51 production increased by around 25,000 bales to 205,000 bales (478 lb. net).

Asia

Russia. Unofficial estimates of the 1950-51 crop have been revised upwards to 3,300,000 bales (478 lb. net), but this figure lacks reliable confirmation.

Middle East. As a result of high prices, cotton growing received a considerable stimulus throughout the Middle East. Latest estimates give the 1950-51 production (with 1949-50 comparisons) as follows: Turkey, 560,000 bales (480,000); Syria, 140,000 bales (80,000); Iraq, 38,000 bales (9,000); Iran, 110,000 bales (94,000). All figures in 478 lb. net bales.

India. Monsoon developments were variable, and yields from the 1950-51 crop failed to come up to earlier expectations. However, largely as a result of the increased planted acreage, production is placed at 2,700,000 bales (478 lb. net), or 350,000 bales more than in the previous season.

Pakistan. Climatic conditions in both Sind and the Punjab were favourable to the 1950-51 crop, and estimates of the harvest have been increased to 1,200,000 bales (478 lb. net), or about 200,000 bales more than the 1949-50 output.

China/Manchuria. Unconfirmed private estimates of the 1950-51 crop give the total production at around 2,500,000 bales (478 lb. net), or nearly 1,000,000 bales more than in the previous season. The quantity used commercially, however, is not believed to have exceeded 1,750,000 bales.

World consumption of raw cotton

On the basis of preliminary official data and private trade reports, prospects for world consumption of commercial cotton this season point to a total of around 31,685,000 bales, compared with 27,915,000 bales last season. The marked increase largely reflects the accelerated worldwide rearmament which followed the outbreak of hostilities in Korea, and a general disposition to build up textile stocks through fears of shortages and rising prices. The United States, Canada, Russia, China and Japan have accounted for the bulk of the expansion in consumption, though a moderate increase has taken place in Western Europe. India, exceptionally, will probably consume rather less cotton than last season, due partly to mill strikes and raw material shortages.

Present very tentative indications point to a world carryover on July 31, 1951, of around 11,740,000 bales, or about 5,000,000 bales less than the figure for a year previous. Of this decrease probably as much as 4,500,000 bales will be accounted for by a reduction of stocks in the U.S.A. The carryovers in other producing countries are unlikely to show any great changes from a year previous, as they were already very low on July 31. Most of the remaining decrease of 500,000 bales will probably be due to reduced stocks in European countries.

WORLD CROPS

OUR NEXT ISSUE will include a review of the **cocoa industry** and an account of the **1951 Cocoa, Chocolate and Confectionery Manufacturers' Conference.**

Following this month's article on the assessment of fodder resources, Dr. R. O. Whyte continues next month with an account of a **Mediterranean survey** of fodder resources which took place early this year.

Other subjects carried by main articles include **improvements in DDT spraying methods** and the **European farm machinery situation.** Besides these there will be other articles and the regular features.

Prices

The decision of the United States authorities last autumn drastically to restrict raw cotton exports resulted in a keen scramble on the part of importing countries to secure alternative supplies. Although establishment of official ceilings checked price advances in the United States, values in other world markets rose spectacularly during the winter months to around the 80d. per lb. level for medium-staple qualities and to over 100d. per lb. for long staples.

After reaching record high peaks in March, prices have since developed a reactionary trend under the influence of an indicated very substantial increase in 1951-52 world cotton production, and diminishing apprehension over the likelihood of the Korean conflict leading to a major world military conflagration. Textile producers, wholesalers and retailers became more cautious in carrying unsold stocks in face of the prospect of more abundant raw material supplies and a possible easing in international political tension.

Conclusions

Removal of all acreage restrictions this year in the United States has resulted in a considerable expansion in the acreage planted to cotton, and the crop has made a very favourable start. Under average growing conditions, a production of at least 16,000,000 bales should be attained, or 6,000,000 bales more than in the previous season.

Larger acreages have also been sown in Turkey, Syria, Iraq, north Brazil, Pakistan and several minor cotton-producing countries and, on broad indications, it would be reasonable to anticipate a 1950-51 world crop of 34,000,000 to 36,000,000 bales according to average climatic conditions. Such a production, if realised, should more than suffice to meet world consumptive requirements during the coming season, though the supply would not be excessive taking into consideration the abnormally low world carryover from the present season.

(From 'The Empire Cotton Growing Review'.)

Women pick tea at the Government Experiment Station at Kawashiro, Shizuoka Prefecture, Honshu. Between the rows of tea bushes are planted yellow lupins; their nitrogen fixing property is utilised as a fertiliser

Tea in Japan — A Review

PETER de JONG

'TEA in Japan' is the title of Report No. 125 of the Natural Resources Section, G.H.Q., Supreme Commander for the Allied Powers, Tokyo, published in December 1949.

This report is an extremely interesting survey of the tea industry in Japan and covers all aspects of tea production. The introduction deals with the historical and statistical aspects of tea in Japan and it is interesting to note that tea was being cultivated in that country as far back as 658 A.D. The second world war caused a considerable decline in tea acreage, but the planted area in 1948 was reported to be some 30,000 hectares (67,533 acres).

The annual yield of tea in Japan, working on figures supplied in the International Tea Committee Bulletin of Statistics for June 1950, is stated to be 850 lb. per acre in 1948. Figures given in Report No. 125 show an average yield of 1,210 lb. per acre for the period 1941-48, but it should be remembered that this figure is based on production of both green and black tea and it is assumed that the output of green tea will be significantly higher than that of black.

Tea cultivation in Japan centres mainly in the southern half of the main island and more than half the planted area is in the Shizuoka Prefecture, near to Tokyo. Tea in Japan is planted largely on hillsides but also on plateaus and in valleys. The soils vary from volcanic ash of low fertility to well-drained alluvial soils of high fertility.

Cultivation

The methods of cultivation of tea in Japan differ considerably from those adopted in south India and the report makes therefore extremely interesting reading. In general, propagation from seed is the normal method practised, but in recent years propagation both by layering and by cuttings is being more and more extensively undertaken. When areas are planted with seed, planting is done direct into the field. Tea is grown in rows from $4\frac{1}{2}$ to 6 ft. apart and seeds are planted very thickly. Some four months after planting, seedlings are thinned out to 2 to 3 in. apart and some six months later are again thinned out to about 6 in. apart. In the third or fourth year of their lives the plants are further thinned, leaving a space of about 12 in. between plants in the row. Where propagation is by layers or cuttings the plants are put out in the first place at 12-in. intervals.

Most of the tea grown in Japan is of the small leaf China hybrid type and is grown completely without shade. Only for the production of a special type of tea (*Gyokuro*) are the plants shaded and then only by the use of artificial shade for a few weeks prior to harvesting. During the initial period of establishment, clearings may be inter-cropped with some form of annual food crop, usually wheat, barley, sweet potatoes or radish.

In the third seedling year after final thinning, a form of pruning to shape the bushes is begun. The plants are cut back to about 10 in. and thereafter for five or six years the new growth is cut back annually to about 4 in. above the old cut in order to develop a dense dome-shaped bush.

Plucking is carried out only three or four times during each year.

PERIODS OF TEA HARVEST IN SAITAMA PREFECTURE

Clipping	*Date*	*Length of period*
1st	Early May	14 days
2nd	June 1-15	7-10 days
3rd	August 15	5-8 days
4th	September 15-25	3-4 days

After the last plucking the terminal shoots are clipped to maintain the shape and size of the bush. Both hand plucking and a form of mechanical plucking are used, the latter being the more popular and being effected with hand-shears to which a small cloth bag is attached to catch leaves as they are shorn from the bush. This semi-mechanical form of plucking is estimated to be from four to six times as quick as manual plucking.

Manuring

Tea is one of the most liberally manured crops grown in Japan and applications of

the major nutrient elements are staggering in comparison with the accepted limits of manuring in India or Ceylon. The rates of application of manures vary from prefecture to prefecture depending, no doubt, on the nature of the soil, but the average application of fertiliser for tea in Japan is nitrogen 354 lb. per acre, phosphoric acid 137 lb. per acre, and potash 200 lb. per acre. These applications are made usually in three doses in March, June and September. A notable feature of fertiliser for tea is the importance attributed to the organic matter as a source of plant nutrients. The recommendations indicate that two-thirds of the N, P and K should be supplied from organic sources and these recommendations are based on the theory that such organic sources of nutrients supply the plant food elements in a form which is available over a long period of time and thereby improve the leaf quality. In this respect it is interesting to refer to the work of Eden in Ceylon (*Monographs on Tea Production in Ceylon, No.* 1) where, commenting on the use of complex organic and inorganic fertiliser mixtures, he says: 'This equivalence of yield response (between organic and inorganic forms of manures) disposes effectively of the " relay-race " theory of nitrogenous manuring and makes a nutritional curiosity of the prescription that contained nitrate of potash, sulphate of ammonia, blood meal, castor cake, groundnut cake, whale guano and bone meal.' However, bearing in mind the poor and light nature of the soils derived from volcanic ash on which much of Japan's tea is raised, it can readily be understood that additions of large quantities of organic fertilisers will have a very beneficial effect on soil structure, and it is interesting to note that a considerable proportion of the N, P and K is derived from the application of a very heavy dressing of mulching grass (over $3\frac{1}{2}$ tons per acre) applied in the autumn of each year.

The main fertiliser applications are made usually during September/October. The soil between the rows is ploughed to a depth of about 12 in. and a furrow about 6 in. wide and 6 in. deep is then made down the centre of the row. The fertiliser is applied and covered in. Further applications are made in the same way in the spring and summer. The heavy grass mulch is spread between the tea rows in July or August; when the September application of manures is made the grass is raked back towards the boles of the plants and, after the fertiliser has been applied, the grass is again spread between the rows. Broken-down mulch is ploughed under in the following March/April.

Insect pests

Tea in Japan suffers from depredations of a large number of harmful insect pests, more than 100 species being reported as injurious to tea. The four species of insect reported as being most harmful are the Smaller Tea Tortrix (*Adoxophyes privatana* Wlk.), the Green Fly (*Chlorita flavescens* Fabr.), the Tea Cochlid (*Phrixolepia sericea* Butl.) and the Tea Tortrix (*Homona coffearia* Niet.). Apart from these, species of thrips and Red Spider are also capable of causing considerable damage.

In considering the question of control of insect pests by chemical methods the report comments that, as the foliage is the part of the tea plant harvested for manufacture, the use of poisonous insecticides is considerably restricted and difficulties in chemical control thereby arise. It is interesting to speculate how much more of a problem this would be if the harvesting of leaf were an all-the-year-round process in Japan as it is in south India and not merely confined to three or four well-defined periods. Problems would be much simplified in India were tea grown along the lines of such a well-defined programme.

There are 43 parasitic diseases of tea listed, of which eight are considered to be of major importance and it is interesting to note that Blister Blight (*E. vexans* Massee) is represented here as well as another related type of fungus disease, Net Blister Blight (*E. Reticulatum*) which appears to be confined to Japan.

Fungoid diseases

The important fungoid diseases are controlled by spray applications of Bordeaux mixtures, the formula recommended being 4-4-80, applied at the rate of approximately 100 gal. per acre, which is the same rate at which insecticidal sprays are usually applied. There are, it appears, certain copper fungicidal sprays manufactured in Japan, which can be substituted for Bordeaux mixtures, approximating no doubt to the commercial fungicides available in India. It appears that for general disease control two rounds of spraying in the spring, one in late April and another in early May, followed by one after each plucking period and a final round in September, are required. From four to seven applications may be necessary for adequate disease control. Japanese tea growers place much confidence in the use of fertilisers for disease control, believing, with considerable justification, that a healthy and vigorous plant is much better able to withstand disease. However, the danger of over-manuring leading to rapid growth of susceptible tissue is also appreciated, and it is interesting to note that the recommendation for the control of Blister Blight is to avoid excess applications of nitrogenous fertilisers.

In the summary at the end of the report it is stated that modern equipment for the application of insecticides and fungicides in the control of tea pests is highly desirable, Most of the Japanese spray equipment is antiquated and dusting has been practised only to a minor extent. No new methods of application, nor new materials, have yet been tested on tea in Japan.

Manufacture

The report concludes with a discussion of the various processes of manufacture of tea in Japan. Two general types of tea are produced, green and black, and the green tea is by far the more important type. Japanese black tea is generally not considered equal in quality to that produced in other countries, due no doubt to the greater attention paid to the manufacture of the special types of green tea. The method of black tea manufacture is similar to that employed in south India, though the machinery used would appear to be somewhat different.

The processing of green teas would appear to be rather complex and extremely specialised. Green teas are divided into unshaded and shaded types, the unshaded types including *Sencha* and *Bancha* teas. Shaded tea is used in the manufacture of *Gyokuro* and *Tencha* teas. Tencha is ground to make the ceremonial tea. The processes involved in the manufacture of green teas are steaming to prevent enzymatic action, followed by rolling under conditions of increasing heat to twist and dry the leaf. The rolling may be accomplished in a series of mechanical rollers or by hand over an open pan heated by a charcoal oven. This is a very simplified description of a series of operations which would appear to require a considerable amount of subjective skill.

Conclusion

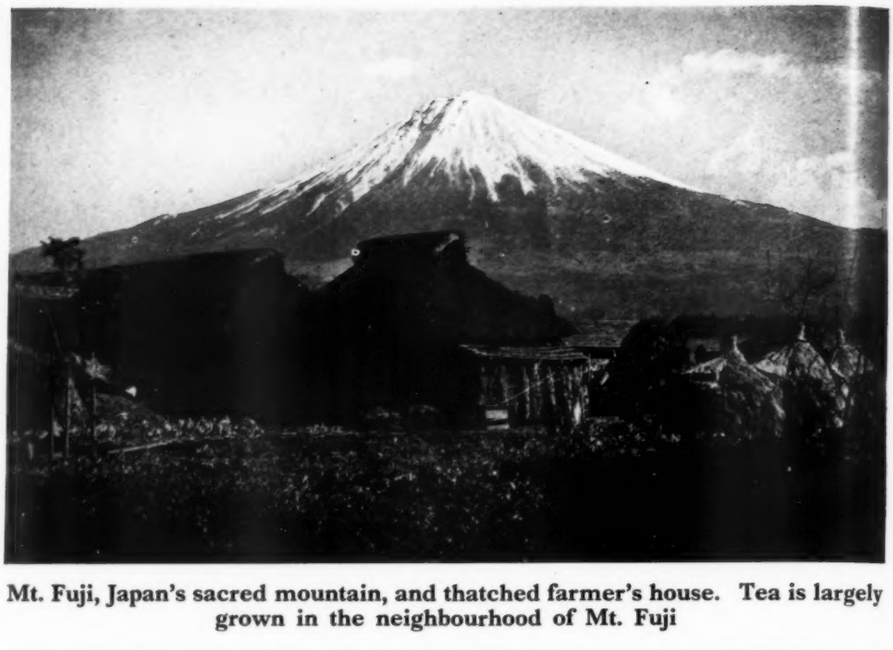
In conclusion, it is interesting to note that the Japanese tea industry of under 70,000 acres supports 14 national and prefectural tea experiment stations, branch stations and similar institutions that conduct research on tea. Research into breeding projects appears to be of priority importance, while attention is given to cultivation and management of tea, control of insect pests and diseases, and study of soil conditions. Tea manufacture is studied at 11 stations. In commenting upon the research organisation in Japan the report says that there is the indication

of lack of co-ordination with over-emphasis on some problems and almost complete neglect of others. There would appear to be a considerable duplication of effort. However, it is also interesting to note that the report suggests that all tea research could probably be conducted in five or six well-equipped Experiment Stations adequately financed, carefully located from the ecological standpoint and staffed with competent personnel. Considering the relatively small acreage involved, even this research organisation would appear to be liberal when judged by Indian or Ceylon standards.

(*From ' The Planters' Chronicle '.*)

Wheat Production Possibilities in Southern Rhodesia

Southern Rhodesia is to make a wheat experiment which may have a far-reaching effect on the country's food prospects, when the Food Production Committee brings 200 bags of summer wheat from Kenya for growing tests in Southern Rhodesia. The wheat will be distributed between 50 and 100 farmers in all parts of the Colony. Officials of the Department of Agriculture will keep a careful watch on the crops at every stage of their growth to see whether summer wheat can be grown successfully on a large scale. Southern Rhodesia's wheat requirements have now risen to 40,000 bags a year, but the Colony grows only about 20,000 bags—and all the rest is imported, mainly from Australia. An official of the Department of Conservation and Extension said recently: ' It is believed that if some of the varieties which are coming from Kenya prove successful as a summer crop in our medium and high rainfall areas, we may be able to produce an appreciable quantity of wheat within the Colony. We might be able to push the total of wheat grown in Rhodesia to 100,000 bags a year or even more. One of the advantages of growing wheat is that it can be mechanised to a greater extent than maize, for instance, and so requires less labour—an important matter now in view of the labour shortage. There is no immediate prospect of Southern Rhodesia's becoming a vast wheat-growing country, but this might well be possible in the future. Large-scale irrigation is the answer. With the development of the Sabi Valley—should it prove, as a result of research, suitable—and other large irrigation schemes there is a real prospect in the years to come of Southern Rhodesia's growing all its own wheat.'



Mt. Fuji, Japan's sacred mountain, and thatched farmer's house. Tea is largely grown in the neighbourhood of Mt. Fuji

Zanzibar's Lime Oil Trials

The *Bulletin* of the Zanzibar Department of Agriculture reports that consideration is being given to the possibilities of a lime oil industry for the island following the examination of samples of oil prepared from ordinary Zanzibar green limes.

The Colonial Products Advisory Bureau in London arranged for the examination of the oil by interested firms and from the results it appears that the oil is basically of good quality, although the odour is a little inferior to that of commercial West Indian distilled lime oil, owing to the high citral content, and the flavour is considered to be somewhat lacking in body and strength. The Department of Agriculture thinks, however, that an oil of considerably better quality would be obtained if produced by the carefully controlled methods of modern commercial practice.

In order to set up a minimum-sized industry about 500 tons of fruit would need to be handled per year. This is estimated to be seven or eight times Zanzibar's present production. As the island has apparently a desirable type of tree and multiplication by seedling production would not present serious difficulties provided private landowners were prepared to invest a little land and money into what may well become a profitable industry, the development of green limes may well be worth while.

Control of Lawn Insects

In many parts of the world much difficulty is experienced by gardeners from the attacks of insects on lawn grasses, which give rise to unsightly patches, ruining tennis lawns, golf greens and so on. These pests include the Japanese Beetle, which in the U.S.A. often causes extensive damage, and a number of cutworms, webworms, leaf hoppers and ants.

Formerly the only means of control consisted of the use of lead arsenate, tobacco dust and such soil fumigants as carbon disulphide, but none of these gave really satisfactory control.

The discovery of the newer chlorinated insecticides has changed the picture. The Connecticut Agricultural Experiment Station has studied the matter and in their publication *Frontiers of Plant Science* have given the results of their experience. They found in 1946 that 10% DDT dust applied at the rate of 250 lb. to the acre gave excellent control of Japanese Beetle and that the insecticide persisted for several seasons.

Even better results were obtained with 5% Chlordane dust applied at the rate of 5 lb. per 1,000 sq. ft., which effectively controlled Japanese Beetle and also cutworms, sodworms and various species of ant. For the latter, Chlordane in the form of 50% wettable powder at the rate of 4 oz. to 75-100 gal. of water per 1,000 sq. ft. was the most successful minimum dosage. Against leaf hoppers DDT gave the best results in the form of wettable powder at the rate of five tablespoonsful in 5 gal. of water per 1,000 sq. ft.

The authorities at the Connecticut Station consider that DDT and Chlordane can be relied upon to control effectively most of the lawn-damaging insects.

RESEARCH DEVELOPMENTS

The Effect of Insecticides on Plants

IT is not uncommon to come across plants which have been damaged by insecticides, but too few of these cases appear in the literature. At a recent spray damage conference, held by the Plant Pests and Diseases Committee, it was agreed that the causes of spray damage were insufficiently known and it was a task for plant physiologists to provide answers to the many aspects of this problem, although frequently plant physiologists 'were unaware of the vast amount of spray damage that occurred annually.'[1]

Not only may insecticides cause necrotic areas on leaves and fruit, leading to leaf fall and fruit drop, but more subtle changes can also be provoked within the plant. Thus Aladjem has reported that 10% Toxaphene dust applied to cotton plants in Egypt caused them to mature earlier, due to an apparent arrest in vegetative growth. By contrast, trials with BHC showed that the insecticide increased vegetative growth and thus delayed boll maturation.[2] Numerous reports refer to the stimulation of plant growth and increased crop yields from plots treated with DDT, Lindane and Chlordane, which were not solely due to absence of insect attack.

Physiological effects of B H C

Recent studies by G. Geister on the effects of BHC[3] have shown that slight overdoses retard the longitudinal growth of stems but have little effect upon the formation of new cells. This may be due to inhibition of plant-growth hormones, for inhibited stems have a hormone content greater than normal. Usually plants held back by BHC catch up later on. This author also found, and the result has been confirmed by Ashby on S. Rhodesian tobacco, that seed germination is unaffected by moderate doses of BHC, but that subsequent seedling growth is delayed. Affected tobacco seedlings have swollen hypocotyls and the rootlet is shorter, stouter and bears fewer root hairs than a healthy seedling.[4]

In varying degrees all the isomers of BHC have this ability to inhibit growth, but the gamma form is the most potent. In minute amounts, however, the isomers can stimulate growth and, at the low dosages needed to control most insect pests, the pure gamma isomer exerts only its growth-stimulant property, but when a technical BHC is applied at equivalent gamma concentration the relatively high content of the other isomers present may retard growth.

Chlorinated compounds on curcubits

It is possible that impurities in some of the other chlorinated insecticides may cause the damage attributed to them. Stunting, chlorosis, leaf burn, the inhibition of side-shoot formation and the downward bending of leaf margins are signs of DDT damage to cucumbers.[5] In America, Carruth and Howe have shown that a 3% dust prepared from DDT of melting point 90°C. damaged the leaves of ' Table Queen ' squashes, while a dust made from purer DDT of melting point 103 to 105°C. was harmless. Similarly dusts made from Lindane are less severe in their effects upon squashes than dusts based on technical BHC.[6]

Parathion effects

Technical parathion contains a number of impurities, chief of which is p-nitrophenol. Recent experiments with tomatoes treated with technical parathion at rates between ½ to 2 lb. per 100 gal. have shown that damaged leaves exhibit an immediate marginal white blotching followed by necrotic spotting several days later. Other later trials have shown that p-nitrophenol causes the immediate reaction, whilst parathion is responsible for the necrotic spots.[7]

DDT, BHC, Chlordane, Toxaphene or methoxychlor are more likely to damage squashes when the foliage is wet. Under dry eastern Oregon conditions Toxaphene has safely been used on some squash varieties, but under moist conditions damage to foliage has occurred. Similarly Chlordane was safe on six varieties whose foliage was dry, but gave damage when the leaves were damp. The authors also conclude that, provided the foliage was kept dry, methoxychlor could safely be used on squashes. Experience such as this may be applicable to crops other than circubits.[8]

Formulation

The way an insecticide is formulated may considerably affect its phytotoxicity and some of the damage attributed to an insecticide may in fact be due to the auxiliary materials with which it has been compounded. Thus, young cabbage was less severely scorched by an experimental emulsion of DDT than by an emulsion containing auxiliary materials (without DDT) at the same strength. Similarly Guesarol E base, without absorbed DDT, injured the cucumbers to which it was applied.[5] In general, wettable powder formulations are less dangerous than emulsions, although considerable differences exist in the kind of damage caused by DDT solvents such as xylene, petroleum oils and various naphthol derivatives.[9] Indeed, even the wetter used may increase the phytotoxic effect of DDT.[10]

Other factors complicate the conditions under which polychlor insecticides may damage plants. Stoker found the growing points of potatoes very less susceptible to BHC than mature leaves, while on cucumbers the youngest leaves were worst affected and showed signs of damage first. The old leaves showed a delayed and much slighter effect. But one month later the same plants were again sprayed, and on this occasion the young leaves were less affected than before and showed only the delayed symptoms.

Effects

There may be marked differences in response to treatment between varieties of the same species, although there is no apparent physiological reason to account for them. Thus there is the unexplained phenomenon of sulphur shyness amongst certain varieties of gooseberry, apple, pear and plum, while DDT dusts and suspensions are reported to have depressed the growth of Triumph but not of Peerless lima beans.[10] Generally, too, the squashes derived from *Curcubita maxima* are more tolerant of chlorinated insecticides than are varieties stemming from *C. pepo*, *C. moschata* or from the genera *Cucumis* or *Citrullus*.

REFERENCES

1. Rept. Spray Damage Conference: *Ann. Appl. Biol.* 1950, **37**, 556.
2. R. Aladjem: *Feuilles Agricole*, 1949, 7 No. 65 pl.
3. E. Geisler: *Nach bl. dtsch. Pft. dienst. Braunschweig*, 1950, **2**, 131.
4. D. G. Ashby: *Ann. Appl. Biol.*, 1950, **37**, 624.
5. R. I. Stoker: *Ibid.*, 1948, **35**, 110.
6. Carruth and J. Howes: *Econ. Ent.*, 1948, **41**, 352.
7. F. Edwards and F. F. Smith: *Ibid.*, 1950, **43**, 471.
8. H. H. Crowell and H. E. Morrison: *Ibid.*, 1950, **43**, 14.
9. N. Turner and N. Woodruffe: *Ibid.*, 1949, **42**, 470.
10. R. E. Wester and C. A. Weyel: *Proc. Amer. Soc. Hort. Sci.*, 1949, **54**, 373.

Mycorrhizal Fungi and Crop Plants

THE symbiotic association of fungal species and the root systems of many plants is well known. Because these fungi are such common ' parasites ' with many crop plants, the so-called ' organic school ' of plant nutrition has put forward the speculation that the development of these symbiotic fungi is a necessary factor in the nutrition of the host plant. Mycorrhizal fungi have been described as nutritional bridges for the plants to which they are attached, and if the soil conditions do not encourage mycorrhizal fungi the diet secured by the plant is incomplete. Lady

Eve Balfour of The Soil Association and the late Sir Albert Howard have expounded this thesis with considerable vigour. They have regarded it as a powerful piece of anti-fertiliser evidence for they contend that most mineral or chemical fertilisers inhibit or completely prevent the growth of mycorrhizal fungi, whereas such fungi are encouraged by composts and organic manures. More orthodox research in plant nutrition has been severely attacked by the organic school for ignoring the significance of mycorrhizal fungi.

Agriculturists who have been impressed with these speculative arguments may not be aware that post-war research has, in fact, tackled this problem. Pre-war and wartime attempts to establish conifer seedlings in Dorset on difficult soil had seemed to support the mycorrhizal thesis, for compost dressings had led to much better establishment than fertiliser dressings. When, more recently, Rothamsted workers under Dr. E. M. Crowther investigated this anomaly it was found that the compost dressings had not been fairly comparable with the fertiliser treatments so far as plant-food contents were concerned. The supply of adequate amounts of plant-food by fertilisers led to satisfactory seedling establishment and growth, and the subsequent development of mycorrhizal fungi was just as vigorous as when compost dressings were given. Crowther suggested that mycorrhizal fungi are not causes of good nutrition for their host-plants, but are, in fact, consequences of good nutrition.

Further, Rothamsted investigations reinforce this point of view. *Rhizophagus* is a common mycorrhizal association with clover and wheat. Dr. Janet Brind has tried to grow red clover with and without *rhizophagus*. It is so far impossible to isolate the fungus and grow it in absence of host-plants, a fact which in itself suggests that the host is more important to the parasite than the parasite is to the host. Soil known to contain the fungus was made into suspensions and diluted to various 'strengths.' These suspensions were applied to pots containing sterilized sand sown with red clover. At dilutions of 1 in 100 the fungus was still sufficiently present to infect the pots but at 1 in 1,000 it was not sufficiently present to do so. It was possible, therefore, to grow clover with and without inoculation with rhizophagus fungus. It was shown that the final dry weights of plants were not significantly different whether or not inoculation had occurred.

(*See Rothamsted Annual Repts.*, 1949, pp. 122-129; 1950, pp. 51-52.)

Herbicides—for Accelerating Rice Maturation

COMBINES have practically supplanted the binder and thresher in rice harvesting in the U.S.A. within the past five years. This has necessitated the use of the drier for conditioning the combined rice for storage. Many new problems have arisen with these changes in procedure and one of the most urgent is that of providing adequate drying and storage capacity for the rice crop grown.

Combining is delayed as long as possible to reduce the moisture content of the grain, but if it is too much delayed the quality may be affected by checking of the grains within the hulls. These checked grains break when milled and may cause the farmer a very considerable loss because of low mill yield of head rice. Some varieties mature more uniformly than others and so are more desirable from this standpoint. However, uneven maturation occurs in individual panicles because of time differences in blooming of the flowers. This is of more common occurrence in rice that matures late in the season when temperatures are relatively low. If by some means the maturation of the panicle could be controlled or the slower parts of the panicle hastened in their maturity, it would be possible to reduce losses now attributable to this factor.

In 1949 some fields in California were sprayed with herbicides by aeroplane to attempt to get more uniform maturation of the rice. Reports of increased mill yield without injury to the rice were claimed, but no definite information could be secured as to the materials or rates used. A preliminary experiment was run in 1950 on Rexark rice near Nome, Texas, using four herbicides, sodium TCA, di-nitro (Dow General), sodium pentachlorophenate and sodium chloroacetate (Dow Defoliant). In the initial tests, the di-nitro and sodium chloroacetate looked most promising as they produced immediate uniform reduction in the moisture content of the grain. They were, therefore, used in a second experiment at 2 qt. of di-nitro and 8 lb. of sodium chloroacetate per acre, respectively. In this experiment, the volumes were varied from 40 to 10 gal. per acre, and equally good results were secured at these volumes. This was to determine whether the lower volumes per acre would give satisfactory results and be economical for aeroplane application.

Experimental

On September 23, aeroplane application was made on Nira rice which would be ready for harvest by approximately September 25. One 5-acre block was sprayed with di-nitro at 2 qt. per acre in 8 gal. of solution per acre. Two gallons of oil were used in the 40 gal. of spray mixture to facilitate spread. Another similar block was sprayed with sodium chloroacetate at 8 lb. per acre in 8 gal. of solution per acre. One half gallon of oil was used in the 40 gal. of spray mixture. Uniform coverage was secured with both of these materials.

At the time of application, the moisture content of the rice in the field varied from 26% in the greenest to 23% in the ripest parts of the field.

Moisture tests were made in the sprayed strips and non-sprayed areas at 2 p.m. each day following application until September 27 when all the rice was cut. A shower fell on the nights of September 26 and 27 and, as a result, there was no change in the moisture content of the untreated areas.

In the area sprayed with the di-nitro, the moisture content was 23.6% on the 25th, 21% on the 26th and 19.5% on the 27th, when cut.

In the area sprayed with Dow Defoliant (sodium chloroacetate), the moisture content was 19% on the 25th, 19% on the 26th and 18.4% on the 27th, when cut. Moisture content of the untreated rice was not lower than 23% when it was cut.

Preliminary milling tests indicate that the yield of head rice from the sprayed areas may exceed 77 lb. per sack, which is very good for this variety.

Germination tests on the rice show that there has been no injury to the germ from the spray treatment.

A second field application was made with Dow Defoliant on Bluebonnet rice on October 5 using 8 lb. per acre in 8 gal. of solution per acre with ½ gal. of oil in the 40 gal. of spray mixture. At the time the spray was applied the moisture content of the rice was 23%. At 4.30 the following day, October 6, the moisture content of the sprayed rice was 16.8%; on the 7th it was 16.4%; and on the 8th, at which time it was cut, it was 16.2%, or 6.8% lower than the untreated field, which was still at 23%.

Delaying harvest more than five days may result in some lodging along levees where the stand is thin, but this probably can be avoided by judicious use of the spray.

Conclusions

These preliminary test indicate, therefore, that the benefits that may be secured include: (1) uniformity of moisture in the combined rice; (2) elimination of high-moisture weed seeds or vegetation as all weeds are killed; (3) increase in volume

capacity of driers; (4) no appreciable impairment to germination was found; therefore it appears that seed lots may be treated as well as milling rice, providing the treatment has no deleterious effect on rice used for food or feed; and (5) there is no adulteration of the brown rice for it has not been possible by chemical analysis to demonstrate the presence of the monochloroacetate on it.

(*From* '*Down to Earth*,' *Vol. VII, No.* 1, 1951.)

Solvent Extraction of Oilseed

IN previous articles in WORLD CROPS there have been many references to methods of extraction of oil from oilseeds. The standard method is by pressure applied either by screw or hydraulic presses.

For many years an alternative method has been that of extracting the crushed seed with solvents such as mineral oil, chloroform, ether or similar liquids. The advantage of this method is the high recovery of oil. For example, residues after extraction by pressure usually retain about 5% of oil while after solvent treatment only 1% is left. The reasons why solvent extraction has not attained great popularity particularly in tropical countries are (*a*) fire risk, (*b*) difficulties of recovering the solvent, (*c*) the high cost of the plant and (*d*) the higher degree of supervision required.

A recent note in our associate journal, *International Chemical Engineering*, indicates that in the U.S.A. solvent extraction processes are now steadily displacing the older methods of extraction by pressure. Progress has been particularly marked during the past ten years and it is now the major technique in this old-established branch of chemical industry. There are today at least eight manufacturers of chemical plant in the U.S. which are marketing large continuous extraction systems.

The solvent most favoured at present is trichlorethylene. It is dearer than hexane or heptane, which were formerly extensively used, gives a higher recovery of oil, while the finished product after recovery is in a high state of purity; moreover, trichlorethylene is less inflammable than hexane or heptane.

It may be added that, as pointed out in the article on 'Tung Oil' by Mr. G. T. Bray, published in the August issue of WORLD CROPS, solvent extraction of tung oil has been found to offer certain advantages and, when normal hexane is used as a solvent, extraction methods enable 99% of the oil present in the kernels to be recovered.

FARM MACHINERY

The Micron sprayer seen at a recent machinery demonstration

'Rotary Atomisation'

A new ultra-low-volume spraying machine capable of spraying 1 gal. of liquid per acre has been developed by Clean Crops Ltd. A 'rotary atomiser' breaks up the spray liquid into practically uniform particles of a mass medium diameter of 100 micron, which are ejected from the nozzle at 120 m.p.h. by an air blast produced by a paddle fan to cover an effective distance of 60 to 80 yds. with any following wind from 2 to 20 m.p.h. The spray liquid passes through no aperture smaller than $\frac{1}{8}$ in. diamater; thus no blocking can occur.

Four types of this machine—the Micron sprayer—have been developed: (1) A self-propelled unit weighing approximately 15 cwt., with a single caterpillar track, the cost of which is £650; (2) a tractor-drawn unit weighing approximately 7 cwt. and priced at £400; (3) the 'anti-locust' model weighing approximately 3 cwt., on a turn-table which can be mounted on any vehicle, *i.e.* Land Rover, jeep, truck, tractor-drawn trailer, etc., costing £250; and (4) a portable unit weighing 70 lb., with a swathe width of 20 to 30 yd. to be carried by two labourers, while a third carries a knapsack containing $2\frac{1}{2}$ gal. of spray liquid, price £200.

The International Industrial Machinery Exhibition, Delhi, 1952

This exhibition is being organised under the patronage of the Government of India by the Association for the Development of Swadeshi Industries. It will be held in New Delhi from February 9 to March 24, 1952. It is designed to help to meet the growing demand in India for industrial machinery of all descriptions, including agricultural machinery. Exhibitors will be given facilities for displaying and demonstrating their machines and booking orders. It will be divided into two sections: (*a*) a Foreign Division intended for manufacturers and distributors of machinery in foreign countries and (*b*) a Home Division intended for Indian firms. Further information about the exhibition can be obtained from the Secretary, Association for the Development of Swadeshi Industries, Chandni Chowk, Delhi (6), India, or from the Commercial Secretaries at the various Indian embassies or offices in other countries.

New Electric Fence Equipment

A new corner tripod for the electric fencing equipment of the Wolseley Sheep Shearing Machine Co. has now been introduced. Claimed to be particularly suitable for stony ground, the tripod is universal in its application.

Other additions to the Wolseley range of electric fencing equipment include a new clip for the 'tent' insulator which is attached to the fence posts in such a way that the cutting of grass under the fence wire can be carried out without obstruction.

Seed Cleaners and Graders

Two models of the Petkus seed cleaner and grader are now being made in Sweden and Germany. Readers may remember that these machines were made in some considerable quantity before the war and found their way into most territories.

The P.33 is the largest model, capable of cleaning $1\frac{1}{2}$ to 2 tons of grain an hour. The aspirating chamber consists of three air ducts. The first is used for pre-cleaning, the second for pneumatic separation, and the third for elevating the treated material to the top sieve. The heavier material pre-cleaned during the first stage is collected at a bagging-off point, while dust and lighter particles are carried to another outlet. Dust from the pneumatic

separating operation is discharged through a wire grille at the top of the machine.

The grain then passes on to the top and bottom sieves, equipped with adjustable beaters and brush gear. It is then conveyed to two indented cylinders of the required size. The good seed travels along the cylinder to the outlet and is elevated to bagging off chutes. Impurities, round weeds, etc., are collected in a tray and delivered to another bagging-off point.

When a chemical dresser is used, the cleaned seed automatically enters this attachment and is subsequently bagged off. A scourer can be fitted over the intake hopper, which is at shoulder height.

The Petkus seed cleaner and grader embodies four separate cleaning processes: (1) pre-cleaning; (2) pneumatic separation—grading by weight; (3) reciprocating sieve action—grading by size; and (4) indented cylinder separation—grading by shape.

The model P.21 is the farmer's machine with a capacity of about 1 ton an hour.

Messrs. Mitchell, Colman & Co. of London handle the sales of the latest Petkus in various territories and countries.

Crushing and Grinding

There is scarcely any industry which does not use either directly or indirectly some form of crushing, grinding and screening equipment.

There are over 20,000 different substances used in various industries which must be crushed or pulverised, many to finenesses of impalpable powder to enable them to be efficiently employed or blended with other substances.

As may be imagined, the selection of the most efficient equipment for a defined purpose requires specialised knowledge and experience, in the use of such machinery in mining, quarrying, road construction, building, agriculture, the food industry, and the many hundred chemical and other industrial enterprises.

No one manufacturer does produce a complete range of dry and wet grinding equipment, for they are too numerous, but International Crushing and Grinding Equipment Ltd., of 7 Ashley Place, Victoria, S.W.1, have designed and built an extensive range of machines for most general uses.

For agricultural grinding I.C.G.E.L. manufacture nine sizes and models of 'Hammamac' Swing Hammer Mills (of which over 12,000 are in general use throughout the world) and also 'Impac' type Grinders, which are the modern equivalent of the old type plate mills. 'Impac' type mills are used extensively for grinding foodstuffs for human consumption.

Tractors for Sokoto Rice Project

Pictures taken during the 136 mile safari of six caterpillar tractors across part of Nigeria. (*Top left*) **River crossing at Bakura.** (*Top right*) **The convoy parked for the night; tight circle was maintained to prevent molesting of personnel by animals.** (*Bottom left*) **Topping up radiators with water at a native village.** (*Bottom right*) **The convoy enters the bush**

Recently the Sokoto Rice Project in northern Nigeria ordered 12 caterpillar diesel tractors and Davis heavy-duty ploughs for delivery before the start of the ploughing season.

This may sound fairly simple, but there was one hitch—the nearest rail terminal was at Kaura Namoda, 136 miles away.

There was not sufficient time to disassemble the tractors and truck them to Sokoto, and permission to drive the tractors on the main road to that area was denied.

The alternative was to 'walk' the tractors across country, through the African bush, at the height of the rainy season when all rivers are in flood. A route was picked and surveyed on foot ahead of time.

But then the rains came and portions of the route were flooded and impassable. A secondary route was then selected, one that called for crossing the Sokoto River at a point where the water was shallow and close enough to an all-weather road to truck in fuel and supplies.

Tractors and drivers assembled at the railhead and prepared for the journey. The drivers were from the Rice Project and required instruction in the operation of the huge track-type tractors. They received two weeks of it.

There were to be two convoys of six tractors each, the second to remain in Kaura Namoda until the first had reached Sokoto. All tractors were equipped with extra fuel and oil drums to enable them to reach the halfway point at the river crossing at Bakura. With two drivers per tractor, the journey commenced.

The first day proved to be the worst; the drivers were nervous and the terrain bad. Only 14 miles were covered in ten hours of continuous driving.

More level country was reached during the second day and the drivers, being more accustomed to the machines, made much better time. The native guide who accompanied the convoy told the villagers along the route that these tractors were for the Sultan of Sokoto himself and, as a result, everything possible was done to help the group on its way.

Bakura, the halfway point and refuelling station, was reached by nightfall of the third day and the Sokoto River crossed without incident.

From Bakura to Sokoto was a matter of three more days, all fairly easy going when compared to the first three.

The second convoy experienced much the same difficulties, but all tractors were delivered intact and in time for the ploughing season to begin.

NEW BOOKS

Fodders and Feeding Stuffs in Malaya

By Gunn Lai Tek, O.B.E., M.A. Fp. iii and 88. Scientific Series No. 24, Department of Agriculture, Malaya. $5.00 (Straits).

This work is an extension of an earlier bulletin produced in 1934 by C. D. V. Georgi on the same subject. It is designed to present for the use of planters and students in Malaya a simple account of the scientific principles underlying the feeding of livestock in the tropics, and of methods of working out rations for the various classes of livestock in Malaya using locally grown fodders and other locally produced feedings stuffs.

As is pointed out in the Preface, our present knowledge of animal nutrition under tropical conditions is meagre, and there are practically no digestibility coefficients for tropical feeding stuffs derived from actual experimentation in the tropics; most of the figures given in the book for digestibility of the various substances examined are derived from calculations based on experimental work in temperate countries on feeding stuffs with similar composition.

The book is, with these reservations, a valuable contribution, which could, with advantage, be used in many other tropical countries, since most of the information is generally applicable while much of the material examined is of common occurrence and usage throughout the tropics.

In three appendices analytical figures are given for the composition, mineral content and vitamin content of 198 Malayan fodders and feeding stuffs, classified under the heads of green fodders, pasture grasses, roots and by-products, dry fodders, concentrates and miscellaneous.

The author has performed a valuable service in collecting this information, which represents the result of a vast amount of analytical work.

It has been referred for criticism to a number of authorities on nutrition in the United Kingdom and can be recommended as a useful handbook on a subject which is of high importance and about which there is too little published information.

It can be obtained from the Department of Agriculture, Kuala Lumpur, Federation of Malaya.

Pesticide Handbook

A comprehensive guide and index to trade names and manufacturers of commercial insecticides, fungicides, herbicides, rodenticides, and pesticide equipment sold in the United States and Canada. By Donald E. H. Frear, M. F. Sunday and S. Friedman. Pp. 158. Commercial Printing Inc. State College, Pennsylvania, 1951, $1.00.

This publication is a continuation and expansion of the book entitled *Pest Control Materials* first published in 1949 under the auspices of the Maine and Pennsylvania Agricultural Experiment Stations.

As stated in the Foreword, the tremendous number of pest control materials and their wide range of composition have created many problems of identity. Consequently a book which provides information on this subject in a reasonably small compass fulfils a definite need.

The book contains an alphabetical list of all trade names and information on the ingredients of these products in the U.S.A. and Canada, including adjuvants, wetting and spreading agents, diluents, repellants, plant hormones and application machinery; in all just under 4,000 preparations are listed.

The book also contains much other useful general information. As a guide to the position in the U.S.A. it is invaluable; from a world point of view its utility would be increased if in subsequent editions it could be made to include similar information in regard to other countries where, especially in Great Britain, there are many other important producers of similar products.

To Authors and Readers

The Editor and Publishers of WORLD CROPS will be glad to consider manuscripts of books submitted for publication. We already publish a number of books on technical subjects, all of which find a world sale and most call for regular reprints and new editions.

Books of a non-fictional type in any language by any publisher can be supplied by the Book Department of WORLD CROPS.

The Story of Twine

Educational Series No. 3. Pp. 70. Illustrated. International Harvester Co., Chicago, 1951.

The use of twine in agriculture, a pioneer development in the machine age of farming, is reviewed in this new educational brochure now being made available by the International Harvester Export Company.

One of a series of booklets devoted to basic developments in the mechanisation of agriculture, this well-illustrated brochure describes the comparatively recent entry of twine into the field of hay and straw baling, dating from the invention of the automatic hay baler in 1939, as well as its more widely known role in grain harvesting.

Described in pictorial fashion through the use of 113 photographs are the various steps in twine production from the growing of henequen and manila plants on plantations throughout the world, down to the final processing in twine mills in the U.S.A. and Canada. In addition there are colourful views of life in Cuba and the Philippines, two principal sources of twine raw materials, and general scenes of binding and baling machines at work.

Also contained in the brochure is a brief summary of agricultural conditions in the world before and after twine came into general use with the invention, in 1877, of the knotting device which made twine binding with the reaper a reality.

Copies of the brochure, CR-214-A, are available in English upon request from Merchandising Services, International Harvester Export Company, 180 North Michigan Avenue, Chicago 1, U.S.A.

New Publications

The following books, published recently, are available from the Book Department, WORLD CROPS, Leonard Hill Ltd., 17 Stratford Place, London, W.1 :—

Agricultural Co-operation in the Commonwealth. By M. Digby. Pp. 172. Blackwell. 15s.

Chemistry and Technology of Food and Food Productions. By M. B. Jacobs. Pp. 857. 2 r.e. Interscience. 96s.

Farming Machinery. By A. B. Lees. Illustrated. Pp. 220. Faber. 21s.

Potato Trials and Collections at East Craigs, 1951 Key to (Dept. of Agriculture for Scotland). H.M.S.O. 1s. 6d.

Selective Toxicity. By A. Albert. 5 plates. 31 diagrams. Pp. 240. Mon. on Biochem. Subjs. Methuen. 7s. 6d.

The Study of Plant Communities. By H. J. Oosting. Pp. 389. Bailey Bros. 37s. 6d.

CORRESPONDENCE

The columns of WORLD CROPS are open to correspondence and the Editor welcomes letters from readers supplementing and commenting on articles or on other matters within our sphere. Limitations of space may necessitate the abridgement of letters.

A Living Collection of Forage Plants in England?

TO THE EDITOR

Dear Sir,

The work being carried on by FAO and ECA on food production problems has shown up a disturbing lack of knowledge as to the correct leguminous plants suitable for varying Mediterranean, Sub-Tropical and Tropical needs.

Much work has certainly been done, but in almost every instance to cover some one specific requirement. There is definite need for co-ordination of such work and collection and correlation of results.

The overriding problem is the same—what is the correct legume for each specific requirement? Whether the initial aim be correct soil control, soil improvement or the most suitable pasture, forage or other plants, the governing point remains centred on the legumes.

In addition to the printed information, it is essential that living plants be available for discussion and comparison. Dried specimens are not sufficient.

Agricultural and trade advisers of many countries entrusted with selection or purchasing the required seeds, are constantly visiting England, and their decisions would be greatly influenced by their being able to see and compare living specimens of plants under discussion. A temperate house is essential. Also essential, is that it should be under the control of an authority having world-wide recognition. Similar gathering of informations together with living specimens of suitable grasses and forage plants should also be undertaken.

May I suggest that England be the centre for this work and that the importance of the matter warrants consideration of the establishment of such facilities under the control of the Authorities of Kew Gardens?

Yours faithfully,

R. W. GUNSON,

August 31, 1951.

20-21 St. Dunstan's Hill,
London, E.C.3.

A British DDT Paste

TO THE EDITOR

Dear Sir,

I read with interest the Editorial article on 'Recent News and Developments—Some Advances in DDT Formulations' in the August issue, but see that only recent American Patents are quoted in the final section.

We would like to point out that a DDT paste was described by this company in 1945 in British Patent No. 601666 and a modification in a later Patent, 634934, a material having been on the market since then manufactured under these Patents, under the name of DeDeTane Paste.

DeDeTane Paste, as its name implies, is an aqueous suspension of micro crystalline DDT containing approximately 50% DDT. It is manufactured by the emulsification of molten DDT with an aqueous emulsifier without oil or solvent. The emulsion is subjected to a heat treatment process which causes crystallisation into rod-shaped crystals, averaging about 7 microns in length by 1 micron diameter. The advantages of such a material are as described in the article in the August issue, but above all probably must be counted the very great powers of suspension ensuring uniformity of application.

Yours faithfully,

G. A. EMERY,
Entomologist.

August 3, 1951.

The Murphy Chemical Co.,
Wheathampstead,
St. Albans, Herts.

Tea in Southern India

TO THE EDITOR

Dear Sir,

The August 1951 issue of your Journal contains an extremely interesting review of the tea industry, but I should like to correct one small inaccuracy regarding the industry in South India.

Your reviewer states: 'In South India the gardens of Travancore in the Nilgiri Hills are also important sources of production.' In fact, there are six major tea-producing districts in South India which make up the 160,000 or more acres. These are the districts of Nilgiris and Wynaad, situated on the slopes and plateau of the Nilgiri massif, and the Anamallais district in Madras State. The three districts of Central Travancore, South Travancore and the High Range, the latter situated on the Cardamom Hills, are all located in the United State of Travancore-Cochin.

That tea in South India is grown at elevations ranging from a little above sea level to over 8,000 ft. and at rainfalls varying from 50 inches to over 300 inches adds point to your reviewer's statement regarding the great contrasts in climate, soil and elevation occurring in the tea-producing areas.

Yours faithfully,

P. DE JONG.

United Planters' Association of
Southern India,
Coonoor, Nilgiris.

August 23, 1951.

The Indian Coconut Journal

In our May 1951 issue we mentioned the *Ceylon Coconut Quarterly*, and in so doing stated that so far as we were aware it was the only journal exclusively devoted to this crop. Our attention has been drawn to the point that this is an error in as much as the Indian Central Coconut Committee has issued for some time past a quarterly journal under the title of the *Indian Coconut Journal*.

This publication is now in its fourth year and we are indebted to Dr. K. P. Menon, Director of the Central Coconut Research Station at Kayangulam, for copies of the third volume.

The journal itself is most informative, and contains not only articles on the work of the research stations of the Central Coconut Committee in India, but also other articles dealing with problems of coconut growing throughout the tropics. It is published by the Indian Central Coconut Committee at Ernakulam, India, and the annual subscription is Rs. 2.

The Indian Central Coconut Committee deals with all matters affecting the coconut industry in India. It maintains a central research station at Kayangulam, and another at Kasagarod in Madras. In addition there are four regional research stations, three in Travancore-Cochin and one in Orissa.

Our Contemporaries

A selection of articles appearing in the October issues of some of our sister journals in the Leonard Hill Technical Group is given below:—

'Food Manufacture': Food Canning on an Island. Food Controls in Great Britain, Part II.

'Manufacturing Chemist': Progress Reports on Fertilisers and Plant Nutrients.

'Muckshifter and Public Works Digest': The Right Size of Excavator. The Selection of Earth-Moving Plant for Public Works.

WORLD CROP REPORTS

AUSTRALIA

Cotton growers need mechanical aid. The introduction of mechanical harvesting of cotton in Australia is effecting a revolution in the industry, and it may eventually open the way for that country to become independent of raw cotton from overseas, reports our Australian correspondent.

Cotton can be grown from the Riverina area of New South Wales to the far north of Queensland, while the Kimberley area of North-West Australia also has great possibilities. But to date the cost of harvesting by hand has proved so expensive that the Queensland crop has dropped from 17,500 bales in 1934 to 1,500 bales this season.

Whereas cotton growing in America was for many years based on a plentiful supply of cheap labour, that is a commodity which Australia has never had. But the introduction of many modern machines into the industry has given Australia an opportunity to establish cotton growing on a sound basis, and to produce cotton as efficiently and as cheaply as it is produced in the United States.

There is an assured market in Australia for all the cotton which can be produced —current requirements by the local spinning industry being at least 70,000 bales of 500 lb. annually.

EAST AFRICA

1950 sugar production. The report of the East African Commissioner for the year 1950 gives the following figures of sugar production in the three East African territories:—

	1949 *Actual* (*Tons*)	1950 *Actual* (*Tons*)	1951 *Estimated* (*Tons*)
Uganda ..	46,107	54,626	55,200
Kenya	11,503	8,553	17,865
Tanganyika ..	7,429	13,726	9,100
Total ..	65,039	76,905	82,165

This increase in production has, however, been more than offset by the rise in consumption, which in 1949 amounted to 78,089 tons for the three territories and is estimated at 96,053 tons for 1950 and 102,640 tons for 1951. The 1950 shortfall was met by the importation of approximately 15,000 tons of refined sugar from the United Kingdom. The 1951 deficiency is to be met by the importation of high grade Mauritius raws (about 19,000 tons) in view of the high cost of refined sugar.

(*From the West India Committee Circular.*)

High tobacco production. The British East African countries' (Tanganyika, Uganda and Kenya) 1951 leaf harvest is tentatively estimated at 11.8 million lb. from 8,645 acres. This compares with 11.1 million lb. from 8,346 acres in 1950. The principal tobacco-producing countries in British East Africa are Tanganyika and Uganda, which are expected to produce 6.5 and 4.6 million lb., respectively, in 1951. During 1950 Tanganyika and Uganda produced 6.1 and 4.1 million lb. of leaf, respectively. Kenya's 1951 leaf harvest is expected to be about 700,000 lb., compared with 845,000 lb. in 1950.

SOUTH AFRICA

Orange Free State increases wheat acreage. A record wheat crop for South Africa is expected if the weather is good, according to the chief regional officer, Division of Soil Conservation and Extension for the Orange Free State and Northern Cape. He said farmers, attracted by the high price of 50s. a bag, were concentrating on producing as much wheat as possible this year. He blamed the shortfall of maize this year compared with last year's crop, partly on the fact that the farmers found it more remunerative to grow wheat, and partly on unfavourable climatic conditions in some of the most important maize-producing areas. Conditions had not been too good in the most important maize-producing areas of the Union. The growing of groundnuts in the Orange Free State, which was started on a large scale six years ago, was increasing steadily. More and more farmers were finding it both a suitable and profitable crop for Orange Free State conditions.

The 1950-51 cotton crop in the Union of South Africa is privately estimated at 14,000 to 15,000 bales (of 500 lb. gross) compared with 6,000 in 1949-50 and an average of only 1,300 bales for the previous 10 years. A crop previously expected to reach 25,000 bales this year was reduced by insect infestation. Potential production under favourable conditions is placed at upwards of 50,000 bales. Current prices paid to growers range from 35.4d. to 35.6d. a lb. for ginned cotton.

Part of the simulus for increased production is provided by a rapidly expanding mill industry that consumed around 42,000 bales in 1950-51 compared with 10,000 in 1946-47. Further anticipated expansion may result in annual mill consumption of nearly 150,000 bales within the next three or four years.

UNITED KINGDOM

June 4 returns. The provisional results of the agricultural census held on June 4 this year in England and Wales show that for several important crops acreages are lower than last year; this applies, amongst others, to wheat, oats and potatoes. On the other hand, the acreage of barley and of certain minor or specialist crops has increased, and the acreage of sugar beet has been approximately maintained. The vegetable acreage is much reduced. The table below shows the 1951 (provisional) crop acreages compared with last year:

ACREAGE OF CROPS AND GRASS IN THE U.K., 1951 (PROVISIONAL)

Description	Thousand acres: June 1950	Thousand acres: June 1951 (Provisional)
Wheat	2,398	2,070
Barley	1,624	1,729
Oats	1,835	1,646
Mixed Corn	827	826
Rye for threshing	67	51
(Total corn)	(6,751)	(6,321)
Beans for stockfeeding	109	101
Peas for stockfeeding	37	33
Potatoes, first earlies	183	138
Potatoes, main crop and second earlies	683	595
(Total potatoes)	(866)	(734)
Turnips and swedes for stockfeeding	300	305
Mangolds	267	254
Sugar beet	419	414
Rape (or cole)	132	132
Cabbage, kale, savoys and kohl rabi for stockfeeding	233	247
Vetches or tares	36	30
Mustard for seed, for fodder or for ploughing in	28	58
Linseed	38	27
Flax for fibre	17	22
Hops	22	23
Orchards, with crops, fallow or grass below the trees	260	262
Orchards, with small fruit below the trees	13	15
Small fruit, not under orchard trees	38	34
Vegetables for human consumption (excluding potatoes) crops under glass and flowers—grown primarily for sale	517	433
Fruit and vegetables, not grown primarily for sale	10	10
Other crops	37	49
Bare fallow	260	376
Lucerne	74	82
Temporary grass:—		
Clover, sainfoin and other temporary grasses:—		
For mowing	2,103	2,313
For grazing	1,382	1,411
(Total temporary grass)	(3,485)	(3,724)
TOTAL ARABLE LAND	13,949	13,686
Permanent grass:—		
For mowing	2,755	2,822
For grazing	7,742	7,948
(Total permanent grass)	(10,496)	(10,770)
TOTAL CROPS AND GRASS, EXCLUDING ROUGH GRAZINGS	24,445	24,456
Rough grazings (a)	5,471	5,437

(a) Includes common rough grazings

PAKISTAN

Wheat forecast. The fourth forecast of the area under wheat crop for 1950-51 is 10,826,000 acres as against 10,591,000 acres reported in the fourth forecast of the previous year, and shows an increase of 2.2%. The acreage of the previous year's final forecast was 10,715,000 acres.

With the exception of East Bengal and Khairpur State there is a general increase in the acreage of this crop throughout Pakistan, attributed to favourable weather conditions and good supply of water. The main increases have been reported by the Punjab, Bahawalpur and N.W.F.P.

Estimated yield of this crop for 1950-51 is 3,928,000 tons as against 3,920,000 tons of the previous year, and shows a small increase of 0.2%. The yield reported in the final forecast of the previous year was 3,958,000 tons. Increased production has occurred in Bahawalpur State and the N.W.F.P., owing to increased acreage under the crop, but this has been largely offset by the decrease in production in the Punjab and Sind brought about by locusts.

CANADA

1951 sugar beet acreage. It is reported that 105,800 acres have been sown with beet this year, which is not far short of the record acreage of 109,000 in 1950. Details by Province are as under :—

	1951 *acres*	1950 *acres*
Alberta	37,200	37,000
Manitoba	21,000	21,000
Ontario	34,600	39 000
Quebec	13,000	12,000
	105,800	109,000

(From Czarnikow and Co's 'Sugar').

WORLD

Coffee production. World exportable coffee production in the 1950-51 crop year now is estimated at about 30 million bags (132 lb. each), substantially higher than an early season forecast of 28.4 million bags and slightly above the 1949-50 exportable output of 29.3 million bags. This compares with an exportable production of 30.6 million bags in 1948-49 and a pre-war (1935-36 to 1939-40) annual average of 35 million bags. Over-production in pre-war years resulted in unremunerative prices and necessitated destruction of millions of bags of coffee for which there was no market. Supply and demand are now in close balance and prices are remunerative.

In addition to the coffee available for export to foreign markets, it is estimated that about 8.4 million bags of coffee were produced for domestic consumption. This gives a total production of 38.4 million bags of coffee in 1950-51. Although there was a slight decrease in coffee consumption in some coffee-producing countries because of higher coffee prices, it has been reported that consumption in certain other producing countries increased.

Harvesting of the 1951-52 coffee crop began in May 1951 in Brazil, Colombia and a few other countries. For the other countries, the harvest of the 1951-52 crop will not begin until about October 1951. Assuming favourable weather, Brazil's crop now being harvested should provide about 18 million bags for shipment to ports. Subtracting 1 million bags for port consumption and coastwise shipments, about 17 million bags will probably be available from the 1951-52 crop for export to foreign markets. Colombia's mid-year crop is estimated at 2.3 million bags for export. If the year-end crop is normal, it should provide about 3.2 million bags for export. Therefore, Colombia's 1951-52 exportable coffee production may be forecast at 5.5 million bags, and this amount, added to the 17 million bags forecast for Brazil, gives a total of 22.5 million bags for these two countries. This is about 2.4 million bags more than the exportable output in these countries in 1950-51.

Crops in some countries undoubtedly will be smaller than in 1950-51, but production in North America and Africa should show a net increase.

Exportable coffee production in 1950-51 totalled 20.1 million bags for Brazil and Colombia and 9.9 million for other coffee-producing countries. If production in these other countries increases 0.6 million bags to a total of 10.5 million, world exportable coffee production in 1951-52 should reach 33 million bags.

SPAIN

Biggest wheat crop in 12 years anticipated. It is estimated in Madrid that this year's wheat crop will be bigger than any since the civil war ended in 1939. This would mean more than 3,600,000 tons. Last year's crop was about 2,800,000 tons.

With 3,500,000 to 4,000,000 tons of wheat, Spain would be able to manage without imports as well as to allow much larger rations.

ANGLO-EGYPTIAN SUDAN

Cotton estimate. The most recent official estimate of cotton production for 1950-51 in the Anglo-Egyptian Sudan placed the 1950-51 crop at 436,000 bales (500 lb. gross weight), or 20% above earlier estimates of 363,000 bales, and 43% higher than the 1949-50 production of 305,000 bales. Cotton area in 1950-51 totalled 539,000 acres, an increase of 25% above the 430,000 acres harvested in 1949-50.

NOW! Solve your Toughest Shredding and Mowing Jobs with a WOOD'S ROTARY CUTTER AND MOWER!

NEW! The most revolutionary agricultural implement in the last few years for general cultivation, improvement of pastures and rotation of crops is the Wood's Rotary Cutter. It is designed to shred corn and cotton stalks, potato vines, cover crops, all straws and stubbles as well as weeds and brushes, including sagebrush. With the Wood's Rotary Cutter, shredded material is left on the ground and used as fertilizer for your next crop. Invaluable for between-season growth on rubber plantations, airports, parks and large estates.

Available in Three Basic Models

The Wood's Rotary Cutter is manufactured in three basic models, each with a different cutting swath extending from 60" to 114" (1.52 to 2.90 meters).

FEATURES:

★ Requires less power than any similar shredder...
★ Low first cost and maintenance...
★ Extra rugged construction assures long, trouble-free operation...

Write for details about the complete line today!

Export Sales Representatives:
GEON INTERNATIONAL CORPORATION
67 Broad Street, New York 4, N. Y.
Or, visit your tractor dealer

WOOD'S
ROTARY CUTTER AND MOWER